THE ISRAEL INSTITUTE OF PRODUCTIVITY
INDUSTRIAL DEPARTMENT
TEXTILE AND LEATHER SECTION

S U R V E Y

EXAMINATION OF THE PROSPECTS FOR PLACING THE BLIND IN THE WEAVING INDUSTRY AS KNOTTING AND TYING-IN OPERATORS

JUNE 1965

PREPARED FOR
THE MINISTRY OF SOCIAL WELFARE
ISRAEL

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by
A . KISHRONI
M . BRAUNSTEIN

• Translated from hebrew issue •

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P R E F A C E

The survey on "Training of the blind in knotting and tying-in of the warp" which was conducted by our staff members Messrs. A. Kishroni and M. Braunstein, constitutes part of supplementary studies made by our section within the framework of our efforts to train the blind and make the most of their inherent skills for work in the textile industry. The survey was carried out on behalf of the Vocational Rehabilitation Administration of the U.S. Department of Health, Education and Welfare, through the Israel Ministry of Social Welfare.

Encouraged by the positive results of the last survey, which dealt with training the blind in cotton and woolen yarn winding, we examined the prospects of placing them in pre-weaving occupations - after bringing them up to a satisfactory level of proficiency. The first stage on which we concentrated and which is the subject of this survey, was the knotting and tying-in of the yarns from the old and new warps respectively. A further study which is completed and will be published in the near future, deals with the drawing-in of the yearn into the eyelets of the heald and its fixing to the reed.

These operations are far more complex than yarn winding, since any mistakes made in winding do not show and result solely in a certain increase of waste, while the faulty drawing-in or missing of a yarn is quite unthinkable considering the resulting flaw along the whole length of the cloth which is prominently visible.

We derive a deep sense of satisfaction from the high degree of accuracy and efficiency achieved in evolving training methods for the blind in this complex occupation, this achievement being the outcome of stubborn experimenting and hard work. Only small enterprises which for economic reasons cannot invest in a knotting machine in the foreseeable future, will be able to employ blind operators who have been trained in the tying-in of unplied yarns. On the other hand there are unlimited possibilities for the employment of blind operators in the knotting of plied yarns, especially for carpet weaving.

We wish to express our gratitude to Mr. I. Evangeles, the blind instructor who untiringly helped us to adapt the complicated and involved working operations to the capabilities and skills of the blind. His perserving work contributed much to the success of this survey.

Our thanks are also due, for his constant and devoted help, to Mr. A. Ohayon, Deputy Director, of the service for the blind at the Ministry of Social Welfare. Finally, we thank the managements and personnel of the following enterprises who assisted us and gave us valuable advice: -

"Ar-Ad"
"Arigey Rappoport"
"Arigey Pick"
"Arkin"
"Trimaco"
"Arpadon"

D. Amir
Director,
Textile and Leather Section.

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Chapter A.: GENERAL

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1. I N T R O D U C T I O N

Within the framework of the existing agreement between the Ministry of Welfare and the Institute for Productivity, under which the prospects for employing the blind in manual knotting and tying-in operations, in the weaving industry, was to be examined, a study of these manual operations as performed by non-blind operators, was held.

The study was conducted at weaving plants employing different forms of operation. The depiction of the operations involving manual knotting and tying-in, must serve as a basis for the evaluation of the prospects for employing the blind in these operations as well as a basis for the establishing of instruction and training procedures.

Tying-in or knotting is one of two forms for the final preparation of the warp, before fixing it on the loom.

The operations consist of connecting the yarns of the old warp with those of the new warp.

There are two ways for effecting the above connection, i.e.

1. By mechanical means.
2. By manual operation.

In this report we shall dwell on the stages of manual knotting and tying-in only. The report is divided into four parts: -

a. General breakdown of the knotting and tying-in operations.
b. Description of existing methods of work in various plants.
c. Analysis of methods, evolving of an improved method for the non-blind operator, and establishing a method for the blind operator.
d. Preparation of a series of lessons for manual knotting and tying-in operations, as performed by blind operators.

The study was conducted at the following plants: -

"Ar-Ad" Ltd.
"Arigey Rappoport" Ltd.
"Arigey Pick"
"Arkin" - A. Falkowitz
"Trimaco" Palestine Textile Industries Ltd.
"Arpadon" Ltd.

2. PURPOSE OF THE SURVEY

The purpose of the survey is to examine the operations involving manual tying-in and knotting, in order to work out training methods for blind operators engaged in these operations.

3. THE KNOTTING AND TYING-IN PROCESS

3.1. General

There are two methods for the final preparation of the warp prior to its fastening on to the loom.

1. Threading in.
2. Knotting or tying-in.

Threading in, consists of passing the yarns of the old warp through the eyelets of the healds and their reeding, this is done when a new pattern is produced having, say, a different number of warp yarns and a different density.

Generally, when the old pattern is identical with the new one, i.e. the number of yarns of the warp and the number of yarns per cm. being equal, then the knotting and tying-in operation is carried out. In the weaving branch two methods of connecting the yarns of the old warp with those of the new one, are known. One, by means of a machine and the second, on which this study is based, manually.

The use of a knotting machine is profitable in a mill which has a large number of looms, each loom having over three thousand warp yarns. The advantages inherent in the use of a machine are its high speed and the uniform quality of the knot.

Since the investment in a knotting machine is not worth while in a large number of existing small enterprises, the manual method of knotting and tying-in is widely practised.

The method of connecting the yarns of the old warp to those of the new warp, is generally by tying-in except in the following instances:-

1) With thick yarns (for weaving upholstery fabrics, carpets, etc.) where the twist of the tied-in yarn is likely to unwind when passed through the eyelet of the heald.

2) With filament yarns that, due to their smoothness, may become untied.

3.2. Description of the working rig (see Figure No.1)

The knotting or tying-in is usually performed at the loom after the completion of the weaving of the old warp. In certain cases, the knotting is done on a special rig, away from the weaving loom. The warp beam is placed either on the floor or on two stands, in front of the loom (near the back rest). The warp yarns are passed over the rest (which is made of wood or iron) which is mounted on two supports (wooden or made of iron).

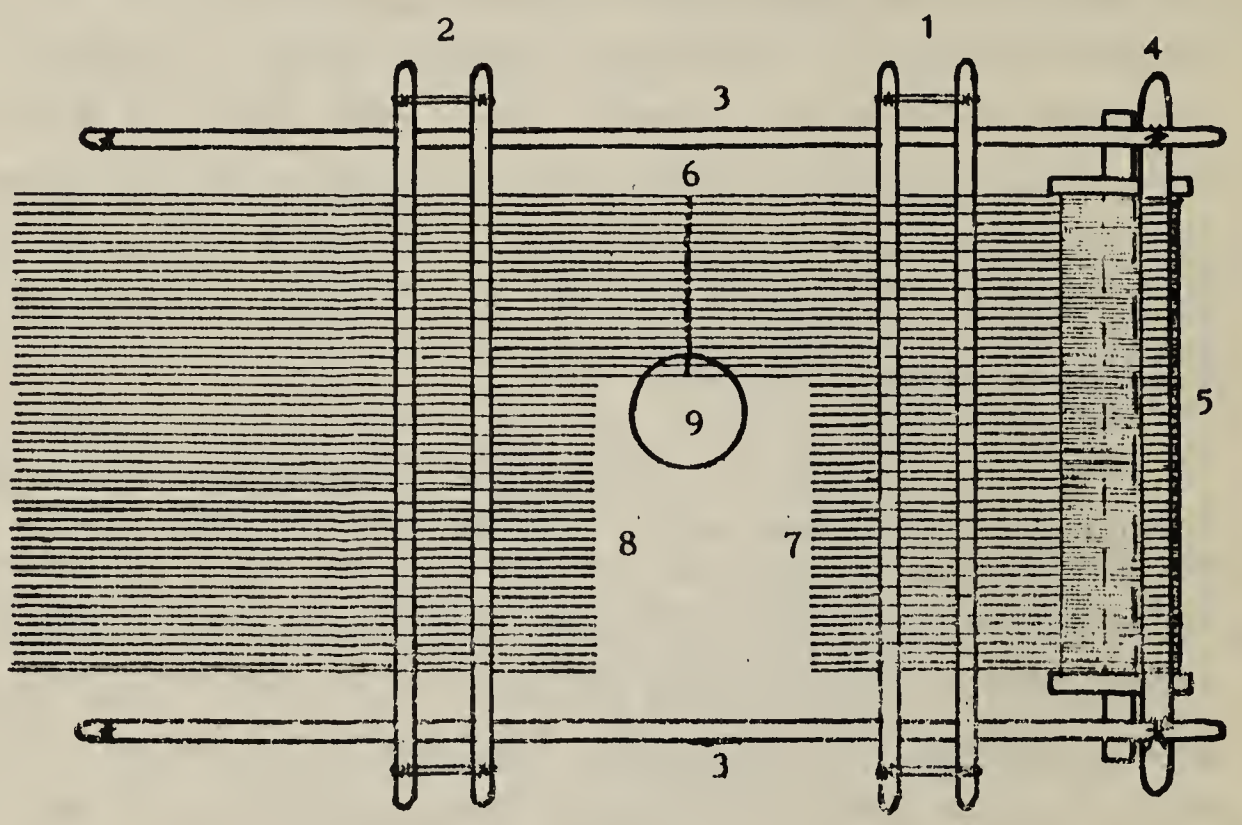
In order to prevent the warp beam from moving during the process of knotting, two wooden posts support the flanges of the beam.

Two supporting wooden rods are tied by ropes, at one end, to the upper bolt of the loom at both sides of the back rest and at their other ends to the back rest. They serve to support the cross rods of both the new and the old warp (the connection of the supporting rods to the sides of the loom differs with every loom; some looms have them attached to the back rest while others are fastened to the member supporting the drop wire, when the back rest islowered). The crossing rods of each warp are interconnected by means of a rope.

The operator engaged in knotting or tying-in, sits on a chair between the two cross rods of the two warps. On his right is the new warp while the old warp is on his left. The strands to be knotten or tied-in are arranged in a parallel fashion in front of the operator at the level of his hips for knotting and higher up for tying-in.

Figure 1

The Working Rig



1. Cross rods
2. Cross rods
3. Supporting rods
4. Back rest
5. Warp beam
6. Knots
7. New warp
8. Old warp
9. Chair for knotting operator

3.3. Auxiliary installations

3.3.1. Supports

At the plants we visited, we saw two supports 80 cms. high. One of these supports was made of wood and was formed by two parts joined together. One part serves as support for the warp beam and the other holds the back rest (see Figure 2).

The second support consisted of a pipe with the base and the upper part, which are of iron, welded to it. The warp beam in this case, was placed on the floor where the pipe was used as a support (see Figure 3).

3.3.2. Cross rods. (Figure 4)

The function of the cross rods is to separate the yarns of the warp. They are usually made out of smooth wood or out of aluminium and their length varies according to the width of the warp. The rods have rounded ends which make it easy to insert them easily between the yarns of the warp.

3.3.3. Back rest

The back keeps the yarns of the warp up to the desired height and is made either of wood or of iron piping.

3.3.4. Supporting rods

These rods are made of piping or wood and serve to steady the cross rods.

3.4. Accessory tools

3.4.1. The hook (for tying-in)

The simple hook (see Figure 5) is made of a wire loop which holds the knots of the ribbons. A rope is connected to both sides of the hook and is fastened around the tying-in operator's waist.

Figure 2

The Stand

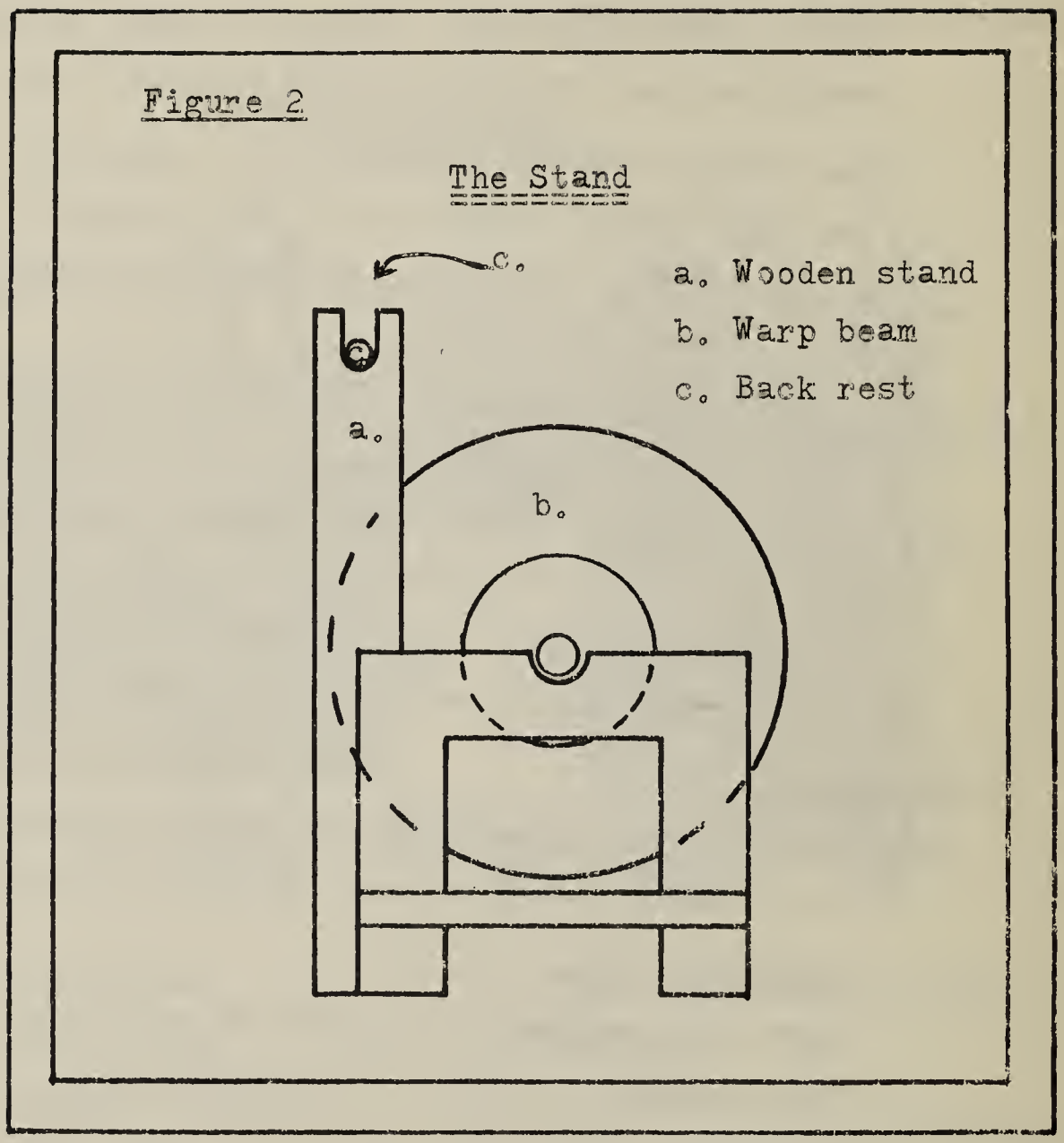
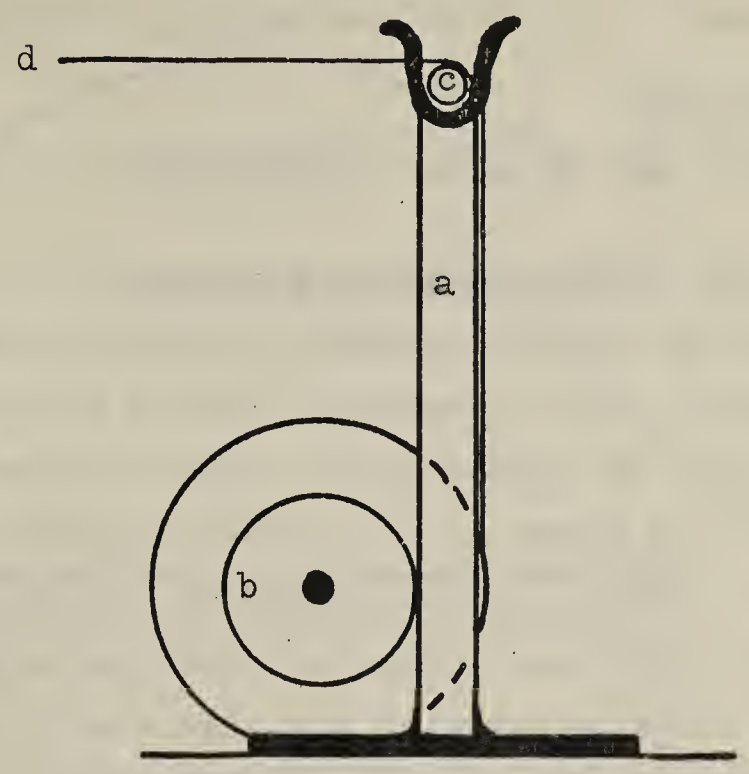


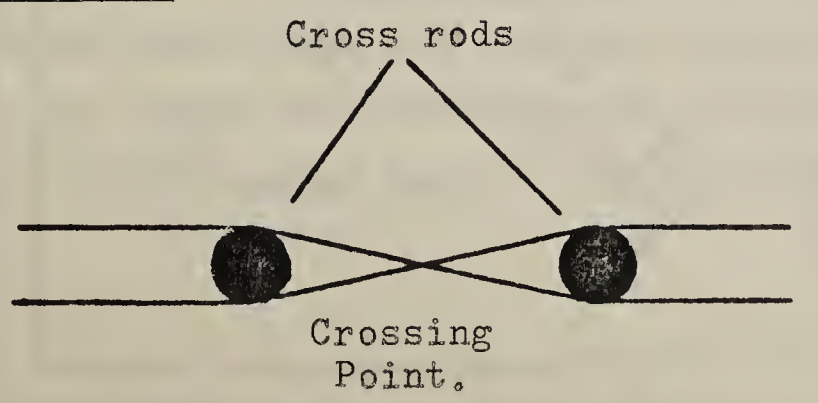
Figure 3

The Stand



a. Metal stand
b. Warp beam
c. Back rest
d. Warp

Figure 4



There are also improved hooks (see Figure 6) which have a metal extension, sharpened at both ends, instead of the loop. This hook facilitates severing of the yarns to be tied-in.

3.4.2. Oil can (for tying-in)

This serves for oiling the ends of the yarn ribbons. The oil makes for better and stronger tying-in.

3.4.3. Scissors

They are used for cutting the ends of the yarn ribbon.

3.5. Description of the knotting process.

The knotting operator grasps two yarn ribbons (from the old and new warp respectively) transfers them to his left hand and holds them in his palm. He subsequently trims the portruding ends of the ribbon, picks out the yarns to be knotted together from the old and new warp and makes a knot. Upon termination of knotting the whole warp, the supporting rods are dismantled and the cross rods are removed. One operator releases part of the warp, while another pulls up the warp yarns by means of a turning winding device. After passing the knots through the eyelets of the heald and between the teeth of the reeds, the broken yarns are repaired. The preparation of the warps for knotting is usually carried out by the knotter. The finishing operations are done by the assistant to the master weaver, with the help of the knotter.

3.6. Description of the tying-in process.

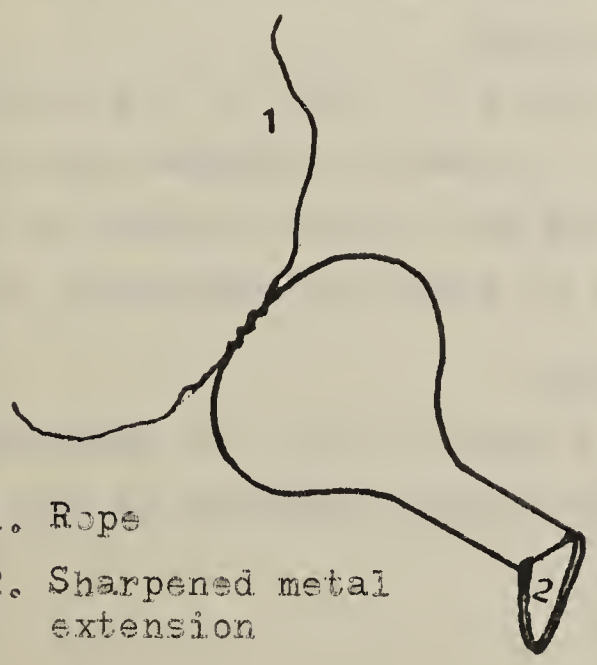
The tying-in operator fastens the hook to his waist, straightens a yarn ribbon from the old warp and ties a knot to it. He repeats this action with a ribbon from the new warp. (Figure 7, detail A.)

Figure 5

The Hook

Figure 6

Hook with Cutting Edge



1. Rope
2. Sharpened metal extension

Following this, the tying-in operator intertwines the two ribbons (Figure 7, Detail 'B'), inserts the knotted ribbons into the hook and, after oiling the ends of the ribbons, starts the tying-in process.

After tying-in all the warp yarns, the operator dismantles the supporting-rods and removes the cross rods. One operator releases part of the warp, while another pulls the warp yarns tight by means of the winding spool. Broken yarns or those that have come apart, are repaired after passing the warp yarns through the eyelets of the heald and between the teeth of the reed.

3.7. Interruption in the course of work.

The following interruptions were observed during the knotting and tying-in processes:-

3.7.1. A missing yarn

In case a yarn from the old warp is missing, the parallel yarn from the new warp should be left out and drawn in at the termination of the knotting or tying-in.

3.7.2. A slipped yarn

Whilst holding the ends of two yarns in his hand, the knotting or tying-in operator may have one yarn slipping out of his grip due to the tautness of the yarns. The escaped yarn must be found and connected in such cases.

3.7.3. A torn yarn

Whenever a yarn is torn, an appropriate length of yarn must be tied to it and connected to the opposite yarn.

4. SUMMARY OF KNOTTING AND TYING-IN PROCEDURES

Manual knotting or tying-in operations can be divided into three parts.

a. Preparatory operations

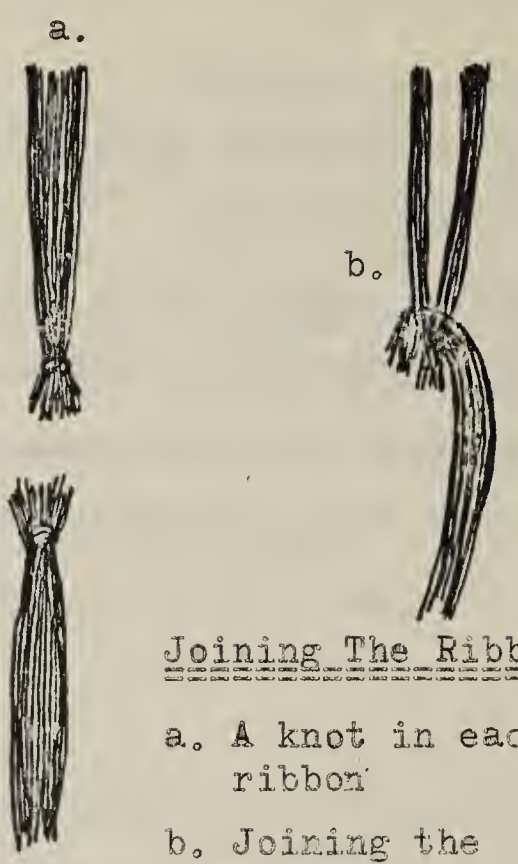
b. Knotting or tying-in operations

c. Finishing operations

The preparatory operations as well as knotting and tying-in are usually performed by the operator himself.

On the other hand, finishing operations are normally performed by the assistant master who is sometimes assisted by the knotting operator.

Figure 7



Joining The Ribbons

a. A knot in each ribbon

b. Joining the ribbons.

Chapter B.: EXISTING CONDITIONS

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1. G E N E R A L

Knotting and tying-in operations are divided into three functions:

a. Preparatory operations

b. Knotting or tying-in operations

c. Finishing operations

The survey was held in six mills, two of which the knotting operations were observed.

Name of Plant	Specification of yarn	Operation
Arkin	Mixed wool and terylene yarn 48/2	Tying-in
Ar-Ad	" " " " " 24/2	" "
Pick	" " " " " 10/1	" "
Rappaport	Combed wool 52/2	" "
Arpadon	Woolen yarn 8/2	Knotting
Trimaco	" " 9/2	"

2. EXISTING CONDITIONS AT THE "AR-AD" PLANT

Specification of the weaving-loom:

Make: Saurer

Year of manufacture: 1956

Classification of loom: Automatic dobby loom.

Description of the warp:

Number of yarns in the warp, including the margin: 3500

Width of the reed: 180 cm.

Width of raw cloth: 160 cm.

Number of shafts: 6

Density of the warp: 24 yarns per cm.

Density of the weft: 14 yarns per cm.

Material: Combed wool 24/2

Colour of yarns: Beige, brown, white.

DESCRIPTION OF OPERATIONS

No.	Name of Element	Start of Element	Sub-element	Description of sub-element	Finishing element
1.	Preparation of the warp for tying-in.	Installation of the warp roll on the rig.	1	Placing the warp on the rig.	Connecting the cross-rods to the supports.
			2	Loosening part of the warp.	
			3	Passing the warp yarns over the back rest.	
			4	Setting-up of supporting rods.	
			5	Fastening of the supporting rods.	
			6	Insertion of the cross rods into the old warp.	
			7	Removal of the crossed ribbons from the old warp.	
			8	connecting the cross rods.	
			9	Insertion of the cross rods into the new warp.	
			10	Removal of the crossed ribbons from the new warp.	
			11	Connecting the cross rods.	

DESCRIPTION OF OPERATIONS (cont.)

No.	Name of Element	Start of Element	Sub-element	Description of sub-element	Finishing element
2.	Tying-in	Fastening the hook around the waist.	1	Fastening the hook around the waist.	Shoving the tied-in yarn forward.
			2	Grasping a ribbon from the old warp and smoothing it out.	
			3	Tying a knot in the ribbon from the old warp.	
			4	Grasping a ribbon from the new warp and smoothing it out.	
			*) 5	Tying a knot in the ribbon from the new warp	
			6	Interwinning two ribbons.	
			7	Insertion of the knots into the loop of the hook.	
			8	Oiling the ribbon ends.	
			9	Finding the yarns for tying in.	
			**) 10	Tying-in.	
			11	Shoving the tied-in yarn forward.	

*) Operations performed with every ribbon

**) Operations performed with every single yarn

DESCRIPTION OF OPERATIONS (cont.)

No.	Name of Element	Start of Element	Sub-element	Description of sub-element	Finishing element
3.	Finishing operations	Dismantling the cross-rods of the old warp	1	Dismantling the cross rods of the old warp.	Examining the warp yarns.
			2	Dismantling the supporting rods.	
			3	Loosening part of the warp.	
			4	Passing of the knots through the heald and the teeth of the reed.	
			5	Examining the warp yarns.	

3. EXISTING CONDITIONS AT THE "ARKIN" PLANT

Specification of the weaving loom.

Make: Crompton-Knowles

Year of manufacture: 1949

Type of loom: Automatic dobby loom

Changeover: Automatic- four colours

Description of the warp

Number of yarns in the warp, including the margin: 2980

Width at the reed: 192 cm.

Number of shafts: 6

Density of the warp: 18 yarns per cm.

Density of the weft: 18 yarns per cm.

The yarn: Polyester with wool 48/2 (Terylene).

DESCRIPTION OF OPERATIONS

No.	Name of Element	Start of Element	Sub-element	Description of sub-element	Finishing element
1.	Preparation of the warp for tying-in	Installation of the warp roll on the rig.	1	Placing the warp on the rig.	Connecting the cross-rods to the supports.
			2	Loosening part of the warp.	
			3	Passing the warp yarns over the back rest.	
			4	Setting up of the supporting rods.	
			5	Fastening of the supporting rods.	
			6	Insertion of the cross rods into the old warp.	
			7	removal of the crossed ribbons from the old warp.	
			8	Connecting the cross rods.	
			9	Insertion of the cross rods into the new warp.	
			10	Removal of the crossed ribbons from the new warp.	
			11	Connecting the cross rods.	

DESCRIPTION OF OPERATIONS (cont.)

No.	Name of Element	Start of Element	Sub-element	Description of sub-element	Finishing element
2.	Tying-in	Grasping the ribbon from the new warp and straightening it out.	1	Grasping a ribbon from the new warp and straightening it.	Shoving the tied-in yarn forward.
			2	Tying a knot in the new ribbon.	
			3	Grasping a ribbon from the old warp and straightening it.	
			*) 4	Tying a knot in the old ribbon.	
			5	Intertwining the two ribbons.	
			6	Tying the hook around the waist.	
			7	Insertion of the knots into the loop of the hook.	
			8	Oiling the ribbon ends.	
			9	Finding the yarns for tying-in.	
			**) 10	Tying-in.	
			11	Shoving the tied-in yarn forward.	

*) Operations performed with every ribbon (except sub-element No.4)

**) Operations performed with every single yarn.

DESCRIPTION OF OPERATIONS (cont.)

No.	Name of Element	Start of element	Sub-element	Description of sub-element	Finishing element
3.	Finishing operations	Dismantling the cross rods of the old warp.	1	Dismantling the cross rods of the old warp.	Examining the warp yarns.
			2	Dismantling the supporting rods.	
			3	Loosening part of the warp.	
			4	Passing the knots through the heald and the teeth of the reed.	
			5	Examining the warp yarns.	

4. EXISTING CONDITIONS AT THE "ARIGEY PICK" PLANT.

Specification of the weaving loom:

Make:	Crompton Knowles.
Year of manufacture:	1950
Type of loom:	Automatic dobby loom.
Changeover:	Automatic, four colours.

Description of the warp

Number of yarns in the warp, including the margin:	2100
Width of the reed:	170 cm.
Number of shafts:	8
Density of the warp:	12 yarns per cm.
Density of the weft:	12 yarns per cm.
The yarn:	Wool 10/1
Colours:	Red, black, grey.

DESCRIPTION OF OPERATIONS

No.	Name of Element	Start of element	Sub-element	Description of sub-element	Finishing element
1.	Preparation of the warp for tying-in	Installation of the warp roll on the rig.	1	Placing the warp on the rig.	Connecting the cross-rods to the supports.
			2	Loosening part of the warp.	
			3	Passing the warp yarns over the back rest.	
			4	Setting up the supporting rods.	
			5	Fastening the supporting rods.	
			6	Inserting the cross rods into the old warp.	
			7	Removing the crossed ribbons from the old warp.	
			8	Connecting the cross rods.	
			9	Inserting the cross-rods into the new warp.	
			10	Removal of the crossed ribbons from the new warp.	
			11	Connecting the cross rods.	

DESCRIPTION OF OPERATIONS (cont.)

No.	Name of Element	Start of Element	Sub-element	Description of sub-element	Finishing element
2.	Tying-in	Fastening the hook around the waist	1	Fastening the hook around the waist.	Shoving the tied-in yarn forward.
			2	Grasping a ribbon from the old warp and smoothing it out.	
			3	Tying a knot in the ribbon from the old warp.	
			4	Grasping a ribbon from the new warp and smoothing it out.	
			*) 5	Tying a knot in the ribbon from the new warp.	
			6	Intertwining two ribbons.	
			7	Inserting the knots into the loop of the hook.	
			8	Oiling the ribbon ends.	
			9	Finding the yarns for tying-in.	
			10	Tying-in.	
			**) 11	Shoving the tied-in yarn forward	

*) Operations performed with every ribbon.

**) Operations performed with every single yarn.

DESCRIPTION OF OPERATIONS(cont.)

No.	Name of Element	Start of Element	Sub-element	Description of sub-element	Finishing element
3.	Finishing operations	Dismantling the cross-rods of the old warp	1	Dismantling the cross rods of the old warp	Examining the warp yarns.
			2	Dismantling the supporting rods.	
			3	Loosening part of the warp.	
			4	Passing the knots through the heald and the teeth of the reed.	
			5	Examining the warp yarns.	

5. EXISTING CONDITIONS AT THE "ARIGEY RAPPAPORT" PLANT.

Specification of the waving loom

Make : Lenz

Year of manufacture: 1955

Type of loom: Automatic dobby loom

Description of the warp

Number of yarns in the warp, including the margin: 4000.

Width of the reed: 175 cms.

Number of shafts: 8

Density of the warp: 21 yarns per cm.

Density of the weft: 20 yarns per cm.

The yarn: Wool 52/2

DESCRIPTION OF OPERATIONS

No.	Name of Element	Start of Element	Sub-element	Description of sub-element	Finishing element
1.	Preparing the warp for tying-in.	Installation of the warp roll on the rig.	1	Placing the warp on the rig.	Connecting the cross rods to the supports.
			2	Loosening part of the warp.	
			3	Passing the warp yarns over the back rest.	
			4	Setting up of the supporting rods.	
			5	Fastening of the supporting rods.	
			6	Insertion of the cross rods into the old warp.	
			7	Removal of the crossed ribbons from the old warp.	
			8	connecting the cross rods.	
			9	Inserting the cross rods into the new warp.	
			10	Removal of the crossed ribbons from the new warp.	
			11	Connecting the cross rods.	

DESCRIPTION OF OPERATIONS (cont.)

No.	Name of Element	Start of Element	Sub-element	Description of Sub-element	Finishing element
2.	Tying-in	Fastening the hook around the waist.	1	Fastening the hook around the waist	Shoving the tied-in yarn forward.
			2	Grasping a ribbon from the old warp and smoothing it out.	
			3	Tying a knot in the ribbon from the old warp.	
			4	Grasping a ribbon from the new warp and smoothing it out.	
			*) 5	Tying a knot in the ribbon from the new warp.	
			6	Intertwining two ribbons.	
			7	Inserting the knots into the loop of the hook.	
			8	Oiling the ribbon ends.	
			9	Finding the yarns for tying-in.	
			**) 10	Tying-in.	
			11	Shoving the tied-in yarn forward.	

*) Operations performed with every ribbon.

**) Operations performed with every single yarn.

DESCRIPTION OF OPERATIONS (cont.)

No.	Name of Element	Start of Element	Sub-element	Description of Sub-element	Finishing element
3.	Finishing operations	Dismantling the cross rods of the old warp.	1	Dismantling the cross rods of the old warp.	Examining the warp yarns.
			2	Dismantling the supporting rods.	
			3	Loosening part of the warp.	
			4	Passing the knots through the heald and the teeth of the reed.	
			5	Examining the warp yarns.	

6. EXISTING CONDITIONS AT THE "ARPADON" PLANT.

Specification of the weaving loom.

Make: Nebulo

Year of manufacture: 1950

Type of loom: Mechanical dobby loom

Changeover: Box type

Description of the warp:

Number of warp yarns, including the margin: 700

Width at the reed: 140 cms.

Number of shafts: 4

Density of the warp: 5.8 yarns per cm.

Density of the weft: 5.8 yarns per cm.

The yarn: Wool 8/2

DESCRIPTION OF THE KNOTTING OPERATIONS

No.	Name of Element	Start of Element	Sub-element	Description of Sub-element	Finishing element
1.	Preparing the warp for knotting	Placing the warp on the floor, near the loom.	1	Placing the new warp on the floor.	Connecting the cross rods to the supporting rods.
			2	Placing a transfer rod.	
			3	Passing the warp yarns over the back rest.	
			4	Setting up the supporting rods.	
			5	Fastening the supporting rods.	
			6	Inserting the cross rods into the old warp.	
			7	Removing the crossed ribbons of the old warp.	
			8	Connecting the cross rods.	
			9	Inserting the cross rods into the new warp.	
			10	Removal of the crossed ribbons of the new warp.	
			11	Connecting the cross rods.	

DESCRIPTION OF THE KNOTTING OPERATIONS (cont.)

No.	Name of Element	Start of Element	Sub-element	Description of Sub-element	Finishing element
2.	Knotting	Grasping a ribbon from the old warp and smoothening it.	(1)	Grasping a ribbon from the old warp and smoothening it.	Shoving the knotted yarn forward.
			*)(2)	Grasping a ribbon from the new warp and smoothening it.	
			(3)	Trimming the ends of the ribbons.	
			(4)	Finding the yarns for knotting.	
			**)(5)	Knotting.	
			(6)	Shoving the knotted yarn forward.	
*) Operations performed with every ribbon. **) Operations performed with every single yarn.					
3.	Finishing operations	Dismantling the cross rods.	1	Dismantling the cross rods on the old warp.	Examining the warp yarns.
			2	Dismantling the supporting rods.	
			3	Loosening part of the warp.	
			4	Passing the knots through the heald and the teeth of the reed.	
			5	Pacing the warp in its place.	
			6	Examining the warp yarns.	

7. EXISTING CONDITIONS AT THE "TRIMACO" PLANT.

Specification of the waving loom

Make:	Nebulo
Year of manufacture:	1953
Type of loom:	Mechanical dobby loom.
Changeover:	Box-Type

Description of the warp

Number of warp yarns, including the margin: 1100

Width at the reed:	160 cms.
Number of shafts:	8
Density of warp:	7 yarns per cm.
Density of weft:	6 yarns per cm.
The yarn:	Wool 9/2

DESCRIPTION OF THE KNOTTING OPERATIONS

No.	Name of Element	Start of Element	Sub-element	Description of sub-element	Finishing element
1.	Preparing the warp for knotting	Placing the warp on the rig.	1	Placing the new warp on the rig.	Connecting the cross rods to the supporting rods.
			2	Placing the back rest in position.	
			3	Passing the warp yarns over the back rest.	
			4	Setting up of the supporting rods.	
			5	Fastening the supporting rods.	
			6	Inserting the cross rods into the old warp.	
			7	Removal of the crossed ribbons from the old warp.	
			8	Connecting the cross rods.	
			9	Inserting the cross rods into the new warp.	
			10	Removal of the crossed ribbons from the new warp.	
			11	Connecting the cross rods.	

DESCRIPTION OF THE KNOTTING OPERATIONS (cont.)

No.	Name of Element	Start of Element	Sub element	Description of sub-element	Finishing element
2.	Knotting	Grasping a ribbon from the old warp and smoothening it.	1	Grasping a ribbon from the old warp and smoothening it.	Shoving the knotted yarn forward.
			*) 2	Grasping a ribbon from the new warp and smoothening it.	
			3	Trimming the ribbon ends with scissors.	
			4	Finding the yarns for knotting.	
			**) 5	Knotting.	
			6	Shoving the knotted yarn forward	
3.	Finishing operations	Dismantling the cross rods	1	Dismantling the cross rods of the old warp.	Examining the warp yarns.
			2	Dismantling the supporting rods.	
			3	Loosening part of the warp.	
			4	Passing the knots through the heald and the teeth of the reed.	
			5	Placing the warp in its place.	

*) Operations performed with every ribbon.
**) Operations performed with every single yarn.

8. SUMMARY OF EXISTING CONDITIONS

At the plants we inspected, we found that three different methods of connecting the yarns of the new warp to those of the old one were practised, viz:

1. Tying-in single handed, at the "Arkin" plant.
   at the "Ar-Ad" plant.
   at the "Arigey Pick" plant.
2. Tying-in with both hands, at the "Arigey Rappaport" plant.
3. Knotting, at the "Arpadon" and "Trimaco" plants.

The preparatory and finishing operations are indentical at most of the plants covered by this survey.

At plants with identical methods, the operations performed are similar. Where connecting operations are concerned, we divided the analysis of the elements into single yarn and single ribbon connections. It is evident that the above elements are repeated for all the ribbons and all the yarns of the warp.

Chapter C.: ANALYSIS OF MANUAL OPERATIONS

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1. G E N E R A L

In this chapter an analysis of the knotting and tying-in operations is presented in chart form, for the right and left hand respectively. As outlined in the preceding chapter, there are three ways of connecting the yarns of the new warp to those of the new one, viz:

1. tying-in with one hand
2. tying-in with both hands
3. knotting

Since the system used in a number of plants surveyed is identical, we have taken one plant for each different system for the purpose of analysing the operations based on the principle of right and left hand diagrammatic representation.

Knotting or tying-in is divided into three functions:

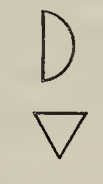
a. preparatory operations
b. knotting or tying-in operations
c. finishing operations

There is no specific system governing the preparatory operations. There is no repetition of operations and the time taken up by preparations constitutes a fraction of the time required for the knotting or tying-in operations. For this reason, it is unnecessary to analyse the preparatory and finishing functions, (which are performed by the master's assistant) in the chart presentation for the right and left hand.

The analysis was confined to the actual knotting and tying-in operations. The data collected, made it possible to find the functions which may present difficulties for a blind operator.

The existing system was chosen as the suggested system, considering a number of limitations.

THE CHART SYMBOLS



○ - Operation

⇨ - Transportation

D - Delay

▽ - Storage

Chart No.1 - ANALYSIS OF RIGHT HAND - LEFT HAND

The Process: Knotting - present system.

The element: Knotting at the "Arpadon" and "Trimaco" works.

No.	The operations	Left hand		Right hand	
		The movement	sign	The movement	sign
1.	Grasping a ribbon from the old warp and straightening it.	- waits	○	-stretches out towards the ribbon from the old warp	⇨
				-grasps the ribbon end	○
				-pulls the ribbon end (to undo the knot)	⇨
		- is passed over the crossed yarn (in order to divide them and straighten them)	⇨	-tautens the ribbon	○
		- grasps the ribbon	○	-transfers the ribbon to the left hand	⇨
2.	Grasping a ribbon from the new warp and straightening it.	- stretches out towards the ribbon from the new warp	⇨	-waits	D
		- grasps the ribbons end	○		
		- pulls the ribbon end (in order to undo the knot)	⇨		
		- tautens the ribbon	○	-is passed over the intersecting yarns (in order to separate them and straighten them).	⇨

Chart No.1 - **ANALYSIS OF RIGHT HAND - LEFT HAND** (cont.)

No.	The operations	Left hand		Right hand	
		The movement	sign	The movement	sign
3.	Cutting the ribbon ends	-holds both ribbons in the palm (with ends extended)	▽	-stretches out towards the scissors	⇨
				-grasps the scissors' handles	○
				-cuts the ribbon ends	○
				-puts the scissors down	○
4.	Finding the yarns to be knotted	-holds the yarns	▽	-stretches out towards the old warp's crossed yarns	⇨
				-seeks out the yarn to be knotted.	○
		-grasps the yarn	○	-places the yarn between thumb and forefinger of the left hand	○
		-holds the yarns	▽	-stretches out towards the new warp's crossed yarns	⇨
				-seeks out the yarn to be knotted	○

Chart No.1 - ANALYSIS OF RIGHT HAND - LEFT HAND (cont.)

No.	The operations	Left hand		Right hand	
		The movement	sign	The movement	sign
5.	Knotting			-coils the yarn from the new warp around the yarn from the old warp (using thumb and forefinger)	○
				-pulls the yarn from below with the middle finger	⇨
		-the index finger and thumb are spread out down-wards in order to form a suitable loop.	○	-holds the yarn end from the new warp	▽
		-holds the yarns.	▽	-forms a loop, with the index finger, the middle finger and the ring finger inside the loop.	○
				-inserts the yarn end of the new warp into the loop-from below.	○
				-pulls the yarn end of the new warp	⇨
6.	Shoving the knotted yarn forward.	-holds both ribbons in the palm.	▽	-is held in front of the yarns.	▽
				-shoves the yarn forward.	⇨

Note: Operations 1 to 3 are carried out with every ribbon.
Operations 4 to 6 are carried out with every single yarn.

Chart No.2 - ANALYSIS OF RIGHT AND LEFT HANDS

The Process: Tying-in, present system.

The element: Tying-in with both hands at the "ARIGEY RAPPAPORT" works.

No.	The operations	Left hand		Right hand	
		The movement	sign	The movement	sign
1.	Tying the hook around the waist.	-waits	D	-stretches out towards the hook.	⇨
				-grasps the hook.	○
				-brings the hook near the body.	⇨
		-grasps the other end of the rope.	○	-grasps one end of the rope.	○
		-brings the rope's end around the waist.	⇨	-brings the rope's end around the waist.	○
		-makes a knot.	○	-makes a knot.	○
2.	Grasping a ribbon from the old warp and straightening it.	-waits	D	-stretches out towards the ribbon	⇨
				-grasps the ribbon's end.	○
				-pulls the ribbon's end (to undo the knot).	⇨
		-straightens out the yarns.	○	-pulls and tautens the ribbon.	○
3.	Tying a knot in the old warp's ribbon.	-grasps near the ribbon's end.	○	-holds the ribbon end.	▽
		-holds the ribbon's end.	▽	-ties a knot.	○
				-pulls the ribbon's end (to tighten the knot).	○
		-releases the ribbon.	○	-waits	D

Chart No.2 - ANALYSIS OF RIGHT AND LEFT HANDS (cont.)

No.	The operations	Left hand		Right hand	
		The movement	sign	The movement	sign
4.	Grasping a ribbon from the new warp and straightening it.	-stretches out towards the ribbon.	⇨		
		-grasps the ribbon's end.	○		
		-pulls the ribbon's end (to undo the knot).	⇨		
		-pulls and tautens the ribbon.	○	-straightens out the yarns.	○
5.	Tying a knot in the new warp's ribbon.	-holds the ribbon's end.	▽	-grasps the ribbon near its end.	○
		-ties a knot.	○	-holds the ribbon.	▽
		-pulls at the ribbon's end (to tighten the knot).	⇨		
6.	Joining the ribbons.	-stretches out towards the ribbon from the old warp.	⇨	-holds the ribbon from the new warp.	▽
		-grasps the ribbon.	○		
		-divides the ribbon in two (using the fingers).	○		
		-passes through the parting in the ribbon.	⇨		
		-grasps the ribbon.	○	-transfers the ribbon from the new warp to the left hand.	⇨
		-pulls the ribbon through the parting	○	-releases the ribbon.	○
		-tautens the ribbon.	○	-waits.	D

Chart No.2 - **ANALYSIS OF RIGHT AND LEFT HANDS** (cont.)

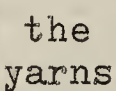
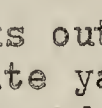
No.	The operations	Left hand		Right hand	
		The movement	sign	The movement	sign
7.	Inserting the knotted ribbons into the loop of the hook.	-holds the hook.		-grasps both ribbons (near the knots)	
				-draws in towards the body.	
		-puts the loop of the hook over the ribbons.		-holds the ribbons.	
8.	Oiling the ribbon ends.	-waits		-grasps the oil can.	
		-rubs the oil into the yarns.		-oils the ribbon ends.	
				-places the oil can in its place.	
9.	Finding the yarn to be tied-in from the new warp.	-stretches out towards the crossed yarns of the old warp.		-stretches out towards the crossed yarns of the new warp.	
		-seeks out the appropriate yarn, using fore and middle finger.		-seeks out the appropriate yarn, using fore- and middle finger.	
		-shoves the yarn forward.		-shoves the yarn forward.	

Chart No.2 - ANALYSIS OF RIGHT AND LEFT HANDS (cont.)

No.	The operations	Left hand		Right hand	
		The movement	sign	The movement	sign
10.	Tying-in (with both hands)	-slides on the yarn in the direction of the body.	⇨	-slides on the yarn in the direction of the body.	⇨
		-waits.	D	-grasps both ends of the yarns.	○
				-tears the yarns with the thumb and fore-finger.	○
		-the thumb and fore-finger tie-in in a clockwise direction.	○	-they turn the ends upwards.	⇨
		-holds the yarn ends.	▽	-folds the yarn ends over the new yarn.	○
		-releases the yarn ends.	○	-ties-in in a clockwise direction.	○
11.	Shoving the yarn forward	-passes over the crossed yarns of the old warp.	⇨	-enters between the yarns (in front of the yarn).	⇨
		-waits.	▽	-shoves the tied-in yarn forward.	⇨

Note: Operations 2 to 8 are carried out with each ribbon.

Operations 9 to 11 are carried out with every single yarn.

Chart No.3 - ANALYSIS OF RIGHT AND LEFT HANDS

The process: Tying-in, present system.

The element: Tying-in single handed at the "Ar-Ad", "Arkin" and "Arigey Pick" works.

No.	The operations	Left hand		Right hand	
		The movement	sign	The movement	sign
1.	Tying the hook around the waist.	-waits.	D	-stretches out towards the hook.	⇨
				-grasps the hook.	○
				-brings the hook near the body.	⇨
		-grasps the other end of the rope.	○	-grasps one end of the rope.	○
		-girths around the waist.	○	-girths around the waist.	○
		-ties a knot.	○	-ties a knot.	○
2.	Taking a ribbon from the old warp and straightening it.	-waits.	D	-stretches out towards the ribbon.	⇨
				-grasps the ribbon's end.	○
		-straightens the yarns.	○	-pulls and tautens the ribbon.	○
3.	Tying a knot in the ribbon from the old warp.	-grasps the ribbon's end.	○	-waits.	D
		-holds the ribbon's end.	▽	-ties a knot.	○
				-pulls the end of the ribbon (to tighten the knot).	○
		-releases the ribbon's end.	○	-waits.	D

Chart No.3 - ANALYSIS OF RIGHT AND LEFT HANDS (cont.)

No.	The operations	Left hand		Right hand	
		The movement	sign	The movement	sign
4.	Taking a ribbon from the new warp and straightening it.	-stretches out towards the ribbon	⇨		
		-grasps the ribbon's end.	○		
		-pulls and tautens the ribbon.	○	-straightens the yarns.	○
5.	Tying a knot in the ribbon from the new warp.	-grasps the ribbon's end.	○	-waits.	▽
		-holds the ribbon.	▽	-ties a knot.	○
				-pulls the ribbon end (to tighten the knot)	○
		-transfers the ribbon to the right hand.	⇨	-grasps the ribbon.	○
6.	Joining the ribbons.	-stretches out towards a ribbon from the old warp.	⇨	-holds the ribbon from the new warp.	▽
		-grasps the ribbon.	○		
		-spreads the ribbon out into two parts (with the fingers).	○		
		-goes through the opening formed by spreading out.	⇨		
		-grasps the ribbon	○	-transfers the ribbon from the new warp to the left hand.	⇨
		-pulls the ribbon through the opening.	○	-releases the ribbon.	○
		-tautens the ribbon.	○	-tautens the ribbon.	○

Chart No.3 - ANALYSIS OF RIGHT AND LEFT HANDS (cont.)

No.	The operations	Left hand		Right hand	
		The movement	sign	The movement	sign
7.	Inserting the knotted ribbons into the loop of the hook.	-holds the hook.	▽	-grasps the two ribbons (near their knots).	○
				-brings nearer the body.	⇨
		-puts the loop of the hook over the ribbons.	○	-holds the ribbons.	▽
8.	Oiling the ribbon ends.	-waits	D	-grasps the oil can.	○
		-rubs the oil into the yarns.	○	-oils the ribbon ends.	○
				-puts the oiling can back in its place.	⇨
9.	Finding the new yarn, to be tied-in.	-stretches out towards the mass of yarns of the old warp (from below).	⇨	-stretches out towards the mass of yarns of the new warp (from above).	⇨
		-seeks out the correct yarn (with the finger)	○	-rests on the cross-rods.	▽
		-shoves the yarn forwards.	⇨	-shoves the yarn to be tied-in with the back of the finger.	⇨

Chart No.3 - ANALYSIS OF RIGHT AND LEFT HANDS (cont.)

No.	The operations	Left hand		Right hand	
		The movement	sign	The movement	sign
10.	Tying-in	-the thumb slides on the yarn in the direction of the tied-ends.	⇨	-waits.	D
		-the forefinger and thumb grasp both yarn ends.	○		
		-tears both yarns.	○		
		-twists the yarns in an anti-clockwise direction.	○		
		-folds the twisted yarn, over the yarn from the new warp.	○		
		-tie-in in an anti-clockwise direction.	○		
11.	Shoving the tied-in yarn forwards	-the back of the finger shoves the tied-in yarn forward.		-waits.	D

Note: Operations 2 to 8 are carried out with every ribbon.

Operations 9 to 11 are carried out with every single yarn.

5. SUMMARY AND CONCLUSIONS

5.1. Determining an improved method for a sighted operator.

After analysing the tying-in operations by means of a chart setting out the operations of the right and left hands, we found that the only difference between tying-in single handed and using both hands, is in operation No.10 - "tying-in".

When tying-in single handed, the left hand does the tying-in while the right hand rests and waits. Conversely, when both hands are used for tying-in they operate in a parallel and symmetrical way.

The number of operations necessary for the knotting is less than those necessary for tying-in (six compared to eleven). The knot is stronger and more uniform than the tying-in, however it is complicated and takes more time. Furthermore, the hook is not used with this system and both ribbons are held in the left palm during the whole knotting operation.

The proposed system for a sighted operator, is the tying-in operation using both hands (see Chart No.2). This system is reliable though the output is lower than with the single handed system, the yarns do not slip out of the hands, the joint is strong and uniform and both hands work in symmetrical fashion.

As regards the knotting method, the present system is proposed for a sighted operator (see Chart No.1).

5.2. Limitations of the proposed method for a blind operator.

The preparatory operations as outlined in Chapter 2, are extremely difficult to carry out, for a blind operator, for the following reasons:

1. The work is not done in one place.
2. The operations are not repeated many times.
3. Most of the operations are based on the function of sight.

The limitations affecting knotting and tying-in are:

a. Coloured patterns, where a missing yarn cannot be found by a blind operator who may join wrong yarns as a consequence. It is therefore desirable that the warp yarns be of a uniform colour.

b. The interruptions as defined in Chapter A 3.7. are liable to cause difficulties. Whenever a yarn is missing, another yarn has to be found, which creates a certain hindrance.

The actual knotting or tying-in does not constitute a problem for a blind operator since even a sighted operator does not use his eyesight while performing these functions.

Chapter D.: A METHOD FOR INSTRUCTING THE BLIND IN KNOTTING AND TYING-IN OPERATIONS.

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1. I N T R O D U C T I O N

The lesson schemes dealing with the instruction in knotting and tying-in operations, which appear in this chapter, were prepared in conjunction with a blind instructor.

As a first stage the trainee will learn all the operations constituting the knotting functions. After sufficient practice he will be able to knot correctly and at the required speed, and pass on to the next, more advanced stage i.e. tying-in with both hands.

It is here that the training of the blind operator in everything connected with knotting and tying-in, actually comes to an end. However, since tying-in using both hands takes a considerable time, a third-higher stage exists, in which the trainee will be taught to tie-in with one hand, only after having tied-in warps using both hands.

The blind will be trained on a special rig. The illustrations shown in this chapter were photographed on such a rig.

The training method was divided into four main parts:

a. Preparation for knotting and tying-in

b. Knotting

c. Tying-in , with the use of both hands

d. Tying-in , using one hand

The lesson schemes for the instruction in those parts, include:-

1. Theoretical material.

2. Explanation of the rig parts and auxiliary equipment.

3. Explanation of the operations.

Each lesson will last fifty minutes and will not include time for the trainee's practicing and becoming proficinet. Each lesson contains instructions for trainee exercises, designed to achieve dexterity of the fingers and speed in knotting and tying-in.

The qualities which are necessary for the success of a trainee are: -

a. dextrous fingers

b. perseverance

c. comprehension

d. basic knowledge at elementary school level.

Candidates will be examined carefully, making use of tests for the blind which will reflect the talents and qualities outlined before.

The method of work for a blind operator described by means of charts for right and left hand operations, is given at the end of this chapter.

Since operations 2 to 8 are identical to both single handed tying-in and tying-in with both hands, these operations are not specified in the chart showing right and left hand operational sequences. Operations 9 to 11 which are carried out differently, are specified in the chart.

2. THE LIST OF EQUIPMENT AND AUXILIARY AIDS

LIST OF EQUIPMENT

1. 4 wooden stands, with bearings for the back rest.
2. 4 wooden cross rods.
3. 4 wooden beams, two to serve back rests and two for supports.
4. A hook.
5. An oiling can.
6. A pair of scissors.
7. A couple of warps of 3000 yarns each. Width 120 cms; Cotton 40/2; Length 2000 metres.
8. A couple of warps of 3000 yarns each. Width 120 cms; Wool 8/2. Length 2000 metres.
9. 4 wooden rods to serve as stops for the warp beam.

N o t e : The quantity of equipment in accordance with the number of trainee couples.

3. LESSONS SCHEMES

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LESSON SCHEME NO.1

Subject: Composition of the cloth

A i m : Familiarity with the composition of the cloth

Location: In the classroom.

1. Explain to the trainee what the cloth is made of:
   The cloth is composed from two sets of yarns:
   The warp - along the length of the material
   The weft - along the width of the material
   Both sets of yarns are arranged in one plane, in a uniform density, at right angles to each other and held together by a weaving joint.

2. Point out the two main kinds of yarn:
   There are two principal kinds of yarns viz.:
   a. single yarns;
   b. plied yarns.
   When a warp consists of single yarns, they are passed through a sizing machine. The sizing which consists of a solution of starch, gives the yarn added strength and makes it suitable for the weaving process. Plied yarns are two or more yarns twisted together.

3. Explain to the trainee what the count of yarns means.
   Each yarn has a number which indicates its thickness.

   The thickness of the yarn is inversely proportional to its number, i.e. the bigger the number of the yarn, the thinner it is, and vice versa.

   Because of the difficulty of gauging accurately the thickness of a yarn, its numerical classification is given by the ratio between its length to its weight. In this country cotton yarn is numbered by the English method and woolen yarns by the metric system of numbering. The relation between the metric and English numbering is 1.7 i.e. a woolen yarn 20/1 equals in thickness a cotton yarn of 34/1.

   Let the trainee feel different numbers of yarns, until he can differentiate between various numbers, by the feeling sense only.

4. Explain to the trainee the meaning of a weaving connection:

The way in which the yarns of the warp are joined to the yarns of the weft is called a weaving connection.

The simplest and most common connection in weaving is: The plain weave.

In this connection each warp yarn is joined to the weft yarn, once above and once below, alternatingly (as in basket work).

LESSON SCHEME NO.2

Subject: The work place

A i m : Familiarisation with the working place and the different rigs.

Location: In the classroom.

*) Description of the rigs and equipment will be accompanied by fingertip feelings of the trainee.

1. Describe to the trainee the premises where the knotting or tying-in is done.

   Knotting or tying-in is usually performed near the loom, in front of the back rest. The warp beam is mounted on two wooden stands. The yarns of the warp are passed over the back rest which is mounted on the two stands. Two wooden rods which pass, on one side over the back rest and on the other side over the transfer rod, serve as supports for the cross rods.

   The operator sits on a chair with the cross rods of the old warp on his left and the cross rods of the new warp on his right.

2. Explain the stand to the trainee:

   The wooden stand consists of two parts, joined together. On its lower part there is a ball bearing which holds the axle of the warp beam. On its upper part another bearing holds the back rest-shaft. The distance between the two stands is governed by the length of the warp beam.

3. Explain to the trainee how the warps are divided:

   Each warp is divided into ribbons, that is, a certain number of warp yarns which are tied together at the ends.

LESSON SCHEME NO.3

Subject: The warp beam and cross rods.

A i m : Familiarisation with the construction of the warp beam, the cross rods and their function.

Equipment: A beam with warp yarns and a couple of wooden cross rods.

Location: In the classroom.

1. Explain to the trainee the construction of the warp beam:

The warp beam serves to hold the warp yarns. It consists of:

a. the wooden body of the beam;
b. two flanges - made of metal
c. the axle of the beam which passes along the whole length and sticks out at both sides.

The two portruding ends of the axle, rest on the stands provided for this purpose.

The warp beam revolves freely. The warp yarns are wound around the body of the beam, in suitable width and length, as well as the necessary quantity.

*) Description of the warp beam will be followed by the trainee feeling the different parts with his fingertips.

2. Describe the cross rods to the trainee:

The cross rods which are normally wooden, are smooth in order to avoid tearing the warp yarns. The rods have sharpened ends, so that they can easily be slipped in, between the warp yarns. The function of the cross rods is to separate the warp yarns at the crossing, thus keeping the sequence and order of the yarns. One cross rod separates all the odd yarns and the other separates all the even ones. The first yarn is passed over the first cross rod and below the second rod. The second yarn passes underneath the first rod and above the second one. The third yarn is arranged like the first. The rods are connected to each other at their ends.

*) let the trainee feel the cross rod and its sharpened end.

LESSON SCHEME NO.4

Subject: The final preparation of the warp before its fixing on the loom.

A i m : a. Familiarisation with the various forms of final preparation before fixing the warp on the loom.

b. To teach the trainee when the different forms are employed.

Location: In the classroom.

1. Explain to the trainee what the two existing forms, for final preparation of the warp are:

There are two ways of preparing the warp prior to its fixing on the loom viz.

a.- drawing-in

b.- knotting or tying-in

Drawing in means passing the warp yarn through the eyelets of the heald and reeding it. This operation is carried out whenever a new pattern is made, for example, the number of warp yarns and the number of warp yarns per cm., are different. Generally, when the old pattern is identical with the new pattern (in cases where the weaving of the pattern is continued), the knotting or tying-in operation is carried out.

2. Explain to the trainee what saving is achieved by joining the new warp to the old one:

Knotting or tying-in is most common in weaving mills. It saves the mill procedures, which must be gone through for drawing-in, such as: removal of the shafts and of the reed from the loom, adjustment of the loom after fixing the warp thereon etc. In addition, knotting or tying-in are performed at great speed and take only one operator against two who work at drawing-in.

3. Explain to the trainee when knotting or tying-in, is used:

Usually the old warp is joined to the new one by means of tying-in. The tied-in yarns are liable to come apart in the following cases, which is the reason knotting is used.

a. with thick yarns (when weaving upholstery fabric, carpets etc.)

b. with filament yarns.

LESSON SCHEME NO.5

Subject: Knots in the ribbons.

A i m : Teaching the trainee the knots employed in knotting and tying-in.

Equipment: A warp divided into yarn ribbons.

Location: In the classroom, near the warp.

1. Explain to the trainee how to tie a knot in the ribbon, for the purpose of joining two ribbons:
   The left hand holds the end of the ribbon. The right hand is slipped under the yarns with the latter above the back of the fingers. When this hand is turned in a clockwise direction, the yarns of the ribbon wind themselves around the fingers.

   The left hand holds the end of the ribbon towards the thumb and forefinger of the right hand, which pull the ribbon end. During the pulling, the left hand directs the loop so that the knot is made opposite the hook.

   Note: This explanation refers to tying the knot in the ribbons of the old warp. The movement of the hands changes for tying a knot in the new warp's ribbons.

   *) Let the trainee perform a number of knots, until he ties them correctly.

2. Explain to the trainee how to undo a knot of a ribbon before straightening the yarns:
   The warp is divided into ribbons tied at their ends. Before straightening the yarns of the ribbon, the operator has to undo the knot. The knot is tied in a manner which enables its undoing by pulling one end.

   The fingers of the left hand are put through the aperture formed by the first cross rod, and slide up to the knot. The right hand gets hold of the ribbon end, and by pulling the end the knot is undone.

   Note: The undoing of the knot, explained above, refers to the ribbon of the old warp. The hand movements change around when the ribbon of the new warp are undone.

   *) Let the trainee undo a number of knots in the ribbons.

LESSON SCHEME NO.6

Subject: Preparing the warp for knotting or tying-in.

A i m : To teach the trainee how to prepare the warp for knotting or tying-in.

Equipment: 4 cross rods, 2 supporting rods, 2 stands, 1 back rest.

Location: In the classroom, near a loom.

1. Explain to the trainee what the preparatory actions are, for knotting or tying-in of the warp:

   a. Placing the warp beam on the two stands.
   b. Passing the yarns over the back rest.
   c. Insertion of the cross rods in place of the cross string, on both warps.
   d. Connecting the two supporting rods.
   e. Connecting the two cross rods.

2. Explain to the trainee how to find the ends of the warp yarns and pass them over the back rest:

   The trainee must find the cross string on the warp beam, must grasp its two ends with both hands, and pull them. One hand holds the yarn ends, while the other hand turns the flange of the warp beam until the yarns are passed over the back rest.

   *) Let the trainee make a number of efforts to find the yarn ends of the warp.

3. Explain to the trainee how to insert the cross rod in place of the cross string. Before transfering the cross rod, the operator separates the warp ribbons. Each rod is transfered separately, ribbon after ribbon, from right to left.

   The operator separates the aperture formed by one cross rod, with both his hands. The left hand enters into the aperture, the right hand proffers the cross rod point to the left hand, which pulls the rod towards the left.
   The above action is repeated for every ribbon of the warp.

After transfering the cross rod, the operator unties the knot of the ribbon and removes the cross string which was substituted by the rod.

The same operation is carried out with the second cross rod.

After transfering the rods in the new warp, the operator does likewise in the old warp.

*) Explain to the trainee the action until he can perform it correctly and accurately.
Correct any wrong moves during the action.

4. Explain to the trainee how to connect the cross rods:

The connecting is done by means of a yarn ribbon. A loop is formed at one end of rod, the ends of the ribbon surround the extremity of the other rod and are tied together with a simple knot. The space between the rods is about 15 cms.

*) Carry out the connecting of the cross rods, together with the trainee, until he can perform the task by himself in the correct manner.

5. Explain and show the trainee how to connect the supporting rods:

The rods are tied by a rope (yarn ribbon) at one end to the back rest, and at their other end to the rest. The cross rods are placed above the supporting rods.

LESSON SCHEME NO.7-8

Subject: Knotting.

A i m: Teaching the trainee how to join the yarns of the old warp to those of the new warp.

Equipment: A rig with a couple of warps.

Location: In the classroom, at a rig.

1. Explain the sitting position to the trainee:

   The knotter sits on a chair between the two pairs of cross rods, with the old warp on his left and the new warp on his right.

2. Explain the straightening of the ribbon yarns from the old warp, to the trainee.

   The left hand rests on the first cross rod of the old warp, slides towards the body and grasps the ribbon yarns.

   The four fingers of the hand are introduced into the aperture of the yarns formed by the said cross rod, with the thumb over the yarns.

   The left hand slides in the direction of the knot, the right hand pulls the end of the ribbon, thus undoing the knot.

   After undoing the knot, the left hand continues to slide to the end of the ribbon and holds on to this end.

   The fingers of the right hand enter between the yarns near the first cross rod and slide towards the end of the ribbon. This action is repeated a number of times.

   *) Let the trainee straighten a few ribbons from the old warp. Pay attention to the correct hand movements.

3. Explain the straightening of the ribbon yarns from the new warp, to the trainee:

   Straightening a ribbon from a new warp is identical to straightening a ribbon from an old warp. The only difference lies in using the right hand instead of the left hand, and vice versa.

*) Let the trainee straighten a number of ribbons from a new warp. Pay attention to the correct hand movements.

4. Explain to the trainee how to hold the ribbons in the palm of the hand:

The ribbons are held by the left hand, at the height of the waist, between the middle finger and the forefinger. The middle finger, the ring finger and the little finger press the yarns into the palm, leaving the forefinger and the thumb free. The back of the hand is turned downwards.

5. Explain to the trainee how the superfluous ends of the ribbons are cut. Since the ribbons are too long for tying a knot, the knotter must cut the superfluous ends, so as to prevent their interfering with the knotting. The right hand holds the scissors and supports the blades with the side of the hand adjacent to the little finger. The hand is lifted slightly in order to cut a few cms. below the hand, and cuts the superfluous ends.

6. Explain to the trainee how to find the yarn from the old warp, which is to be knotted:

The left hand holds the ribbons tautly, with the thumb and forefinger free. The right hand swings towards the left and towards the cross rods of the old warp, where it is placed on the first rod. The forefinger slides along the rod in the direction of the body, shoves the ribbon yarns away, slides towards the crossed yarns and separates the yarn.

The thumb separates the yarn from the other side of the rod, the forefinger and thumb slide to the end of the yarn, where they pull to extract the yarn from among the other yarns and place it between the forefinger and thumb of the left hand.

Note: In case the yarn does not separate after sliding along the first rod, it is necessary to slide with the finger along the second rod. It is desirable to remember on which rod the finger was slid last, in order to avoid repetition.

7. Explain to the trainee how to find the yarn from the new warp, which is to be knotted:

   The left hand holds the ribbon tautly in the palm and the old yarn, which is to be knotted, between forefinger and thumb.

   The right hand swings to the right - towards the cross rods of the new warp, and is placed on the first rod (or on the second - see note above). The forefinger slides along the rod in the direction of the body, picks out the ribbon yarns, slides towards the crossed yarns and separates the yarn. The thumb and forefinger slide along the yarn to its end, where they separate it from the rest of the yarns.

8. Explain to the trainee how to tie the yarn from the new warp to the yarn from the old warp:

   The forefinger and thumb of the right hand transfer the new yarn over the old one towards the body, the back of the middle finger hooks the yarn from below while the ring finger presses it to the middle finger, both pull upwards while the forefinger and thumb grasp the end of the yarn (the new yarn goes around the old yarn). The forefinger and thumb turn clockwise, the yarn is wound around the fore- and middle fingers, the fingers being vertical to the yarns (thus a loop is formed).

   The left hand holds the ribbons and the old yarn. While making the loop, the forefinger and thumb slide towards the body in order to form a suitable loop. The thumb of the right hand inserts the yarn end of the new warp between the fore and middle finger. They pull and tauten the end of the yarn, while the left hand tightens the yarn end from the new warp.

9. Explain to the trainee how to shove the knotted yarn:

   In order that the knotted yarn shall not hamper knotting activities, the right hand releases the ends of the knotted yarn downwards and shoves the yarn, away from the body, with the back of the fingers.

TRAINING INSTRUCTIONS

a. Let the trainee perform each operation separately.
b. Combine actions Nos. 2 - 5.
c. Let the trainee knot a ribbon of yarns.
d. Let the trainee knot the whole of the warp.

LESSON SCHEME NO.9-10

Subject: Tying-in with both hands.

Aim: To teach the trainee the tying-in of the yarns from the old warp with the yarns of the new warp.

Equipment: A rig with two warps.

Location: In the classroom, at the rig.

1. Explain the sitting position to the trainee:

   The operator who does the tying-in sits on a chair between the two pairs of cross rods, with the old warp on his left and the new warp on his right.

2. Explain the hook to the trainee:

   The hook is made of wire; a rope is attached to tis rear part and to its front a steel part is welded, which has two sharpened sides that facilitate the tearing of the yarns during the tying-in process.

   The hook is held to the operator's waist by means of a rope. The sharpened part of the hook is above the tying-in operator's navel.

   *) The description of the hook will be followed by the trainee's feeling its parts with his fingertips.

3. Explain to the trainee what the actions preceding the actual tying-in, consist of:

   After tying the hook around his waist, the operator takes a ribbon from the old warp and straightens it (in a manner similar to that of straightening the yarn for knotting, see lesson scheme No.7-8). He then, ties a knot which will allow the joining of the ribbons.

   A similar action is performed by the operator for the first ribbon of the new warp.

4. Explain to the trainee how to join two ribbons:

The right hand holds the end of the old yarn, the left hand is inserted through the aperture formed by the first cross rod, and slides up to the knot in the ribbon. The right hand grasps the knot of the new warp ribbon and passes it to the left hand which pulls it, thereby effecting the joining.

5. Explain to the trainee how to insert the ribbon knots into the loop of the hook:

The right hand holds the hook while the left hand holds the ribbon knots. Both hands are brought together, the left hand pushes the knots from above into the loop of the hook. The right hand pulls the knots from below the hook and pushes them away from the body.

6. Explain to the trainee how to oil the ends of the ribbons:

The right hand holds the oil-can, the left hand holding the ends of the ribbons near the hook. The spout of the oil-can is directed towards the yarns held in the left hand. The right hand oils while the left hand rubs the oil well into the yarns.

7. Explain to the trainee how to find the yarns which are to be tied-in:

During the tying-in with both hands, the actions of both hands are parallel i.e. the left hand seeks out the yarn of the old warp, while the right hand seeks out the yarn of the new warp, at the same time - both hands working above the yarns.

Finding the yarn is similar to finding the yarns for knotting (see lesson scheme No.7-8).

8. Explain to the trainee how two yarns are tied-in.

The thumb of the left hand slides along the yarn of the old warp, in the direction of the hook. The right thumb slides along the yarn of the new warp. The forefinger of the right hand grasps the yarn of the old warp, near the hook and by pressing the yarns together and pulling - they tear. The right hand turns the torn yarn ends upwards, the thumb and forefinger of the left hand tie the ends in, in a clockwise direction.

The thumb and fore-finger of the right hand press the tied-in ends against the yarn of the new warp and tie-in, clockwise.

9. Explain to the trainee how the tied-in yarn is shoved forward:

The right hand enters to the right of the tied-in joint and the left hand enters to the left, both hands then shove the yarn forward, with the back of the fingers.

TRAINING INSTRUCTIONS

a. Perform each action separately.
b. Let the trainee tie-in a yarn ribbon.
c. Let the trainee tie-in the whole warp.

LESSON SCHEME NO.11

Subject: Tying-in with one hand.

A i m : To teach the trainee the tying-in of yarns with one hand.

Equipment: A rig with two warps.

Location: In the classroom, near the rig.

1. Explain to the trainee the difference between tying-in with both hands and tying-in using only one hand:

   The number of operations performed for tying-in with boths hands, is the same as for tying-in with one hand. Most of the operations are similar. The main difference lies in the actual tying-in process. There are two more differences, in finding the yarn and in shoving it forward after tying-in: -

   When tying-in with one hand, the left hand gropes for the yarn to be tied-in - underneath the yarns of the ribbon, while when tying-in with both hands, the hand seeks the yarn from above the ribbons.

   Shoving the yarn after tying-in with one hand, is done with the back of the left forefinger. When tying-in with both hands, both of them shove the yarn forward.

2. Explain to the trainee how to tie-in the two yarns with one hand:

   The right hand waits. The thumb of the left hand slides from below, along the yarn from the old warp, towards the hook. The forefinger grasps the new yarn. The forefinger and thumb press the yarns together, pull them (by doing so the yarns are torn) and tie-in partially in an anti-clockwise direction. Subsequently they fold the tied-in yarn over the yarn from the new warp and perform an additional and final, anti-clockwise tying-in.

TRAINING INSTRUCTIONS

a. Let the trainee tie-in ribbon of yarns.
b. Let the trainee tie-in the whole warp.

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Fig. 1 Straightening of the yarns

Fig. 2 Holding the yarns in palm of hand

Fig. 3 Separating the yarns of the old warp

Fig. 4 Holding the yarn between the thumb and the fore-finger

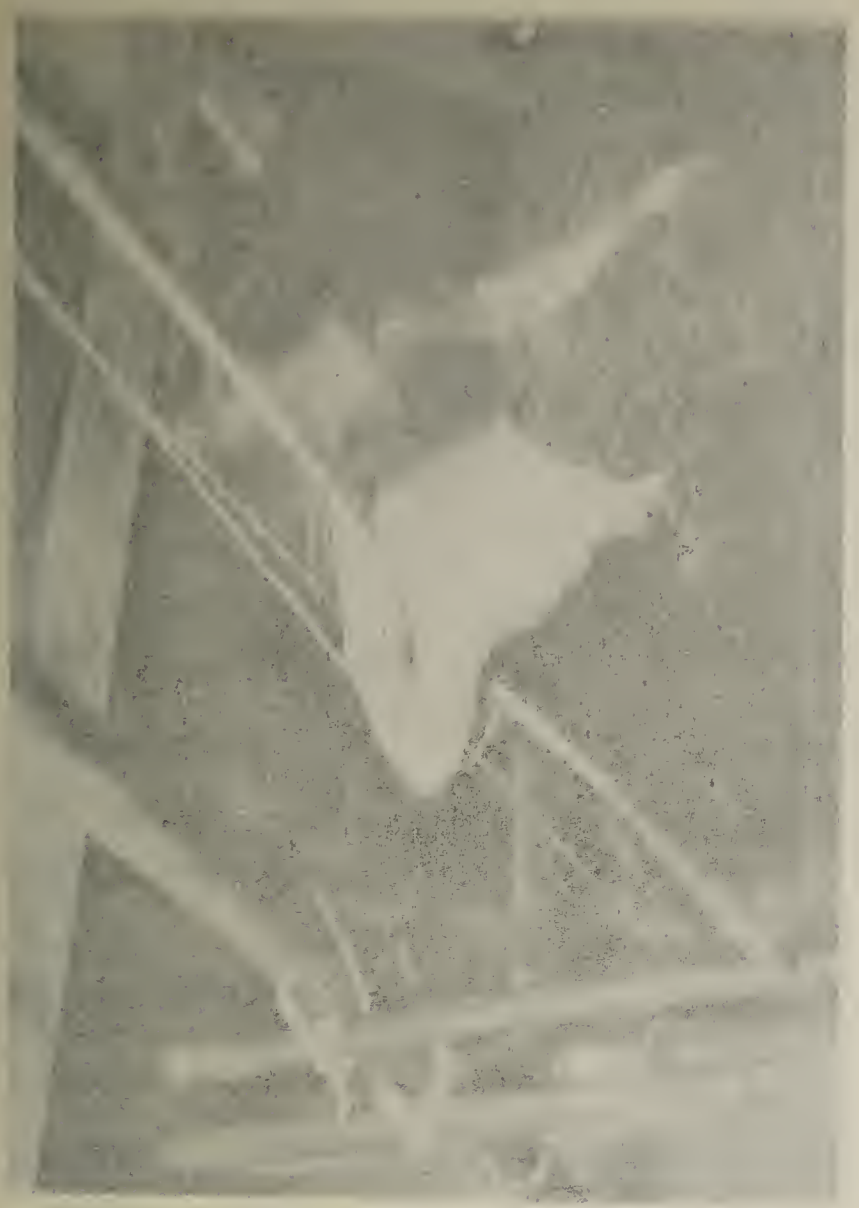


Fig. 5 Separating the yarn of the new warp

Fig. 6 Passing the yarn of the new warp round the yarn of the old warp

Fig. 7 Hooking the yarn with the middle finger

Fig. 8 Passing the yarn's end between the fore and middle finger

Fig. 9 Pulling the ends of the yarns

Fig. lo Shoving the knotted yarn forward

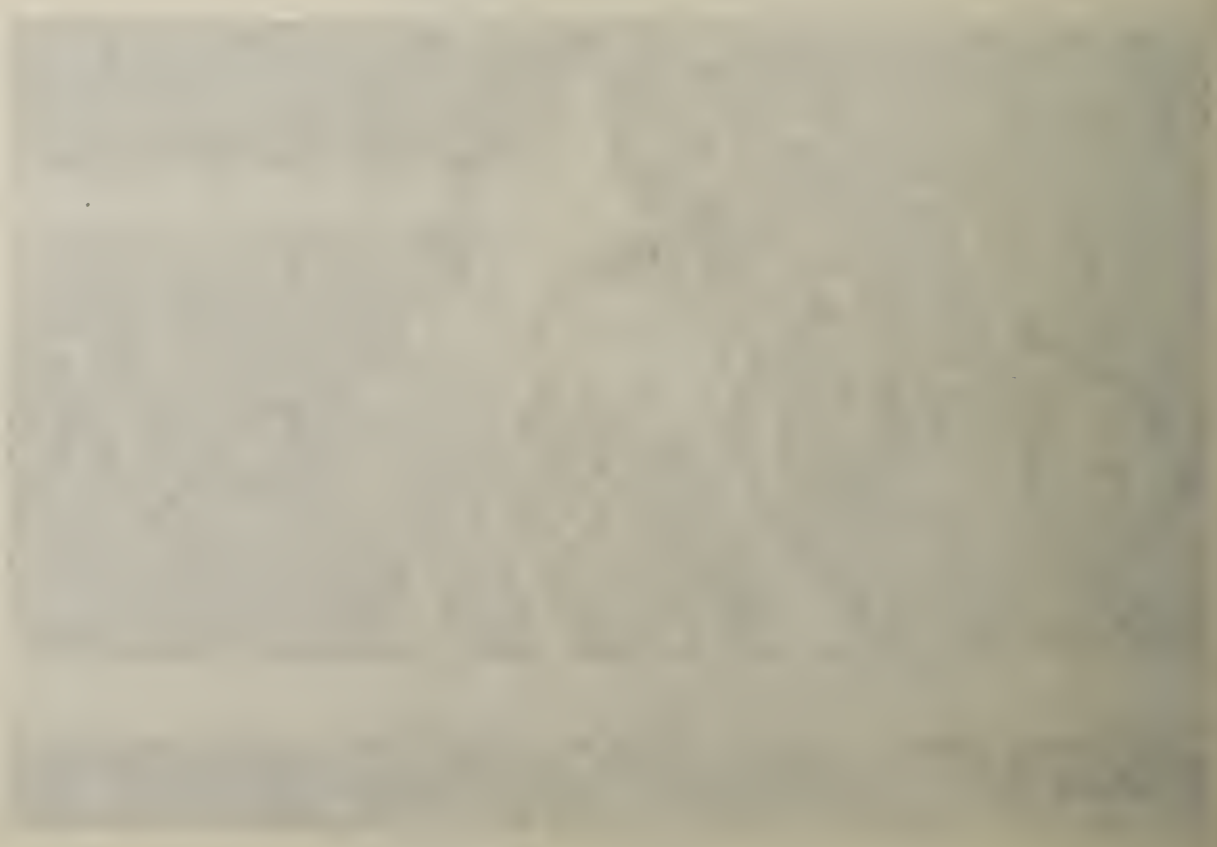


Fig. 11 Straightening of the yarns

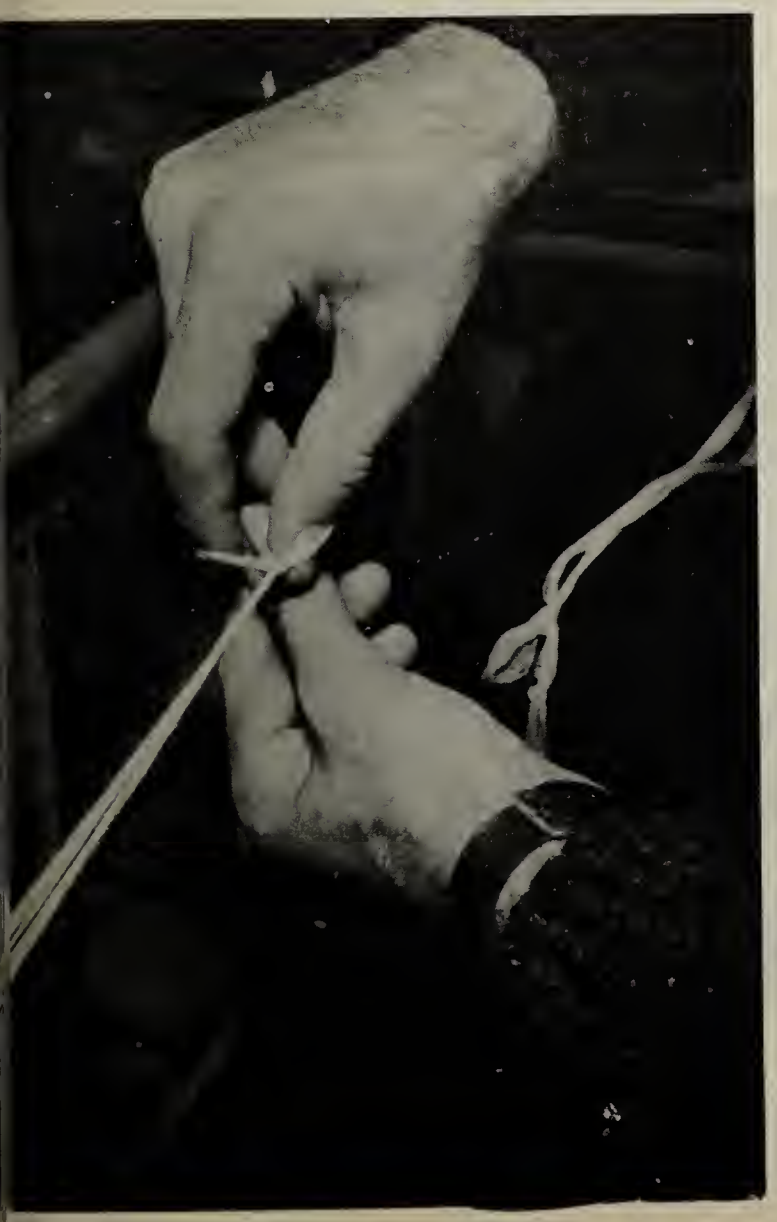


Fig. 12 Knotting the ribbon of the old warp

Fig. 11 Straightening of the yarns

Fig. 12 Knotting the ribbon of the old warp

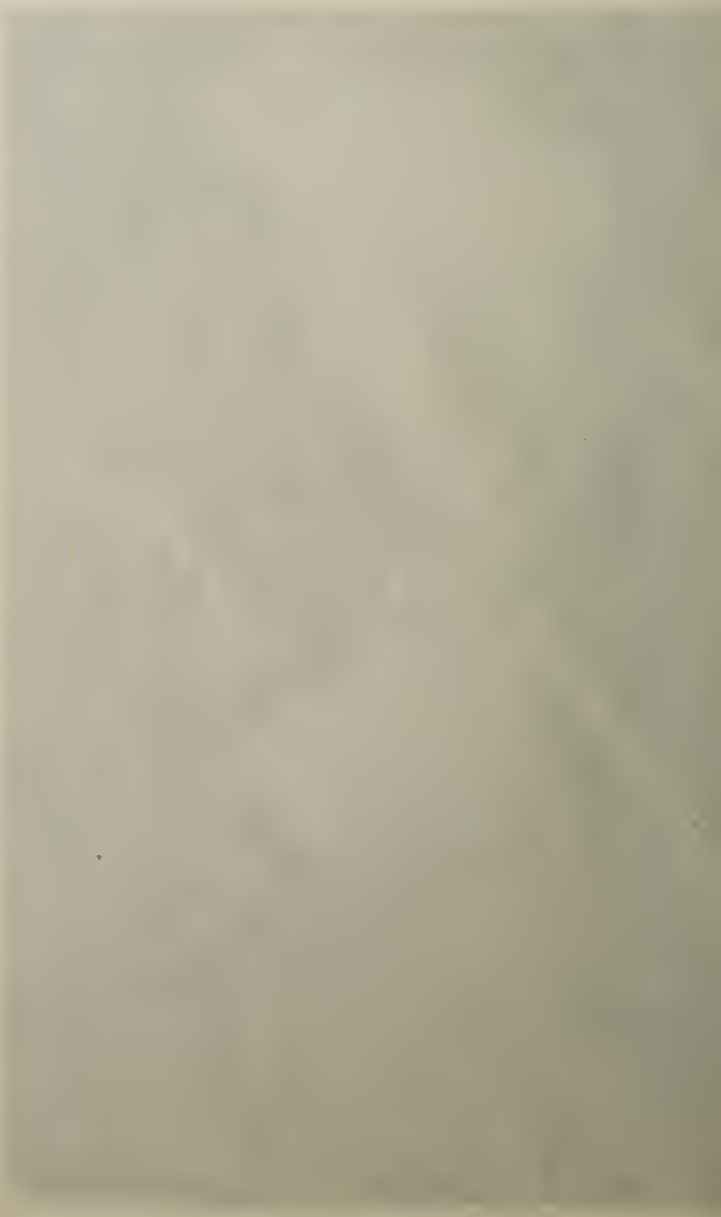


Fig. 13 Joining the ribbons

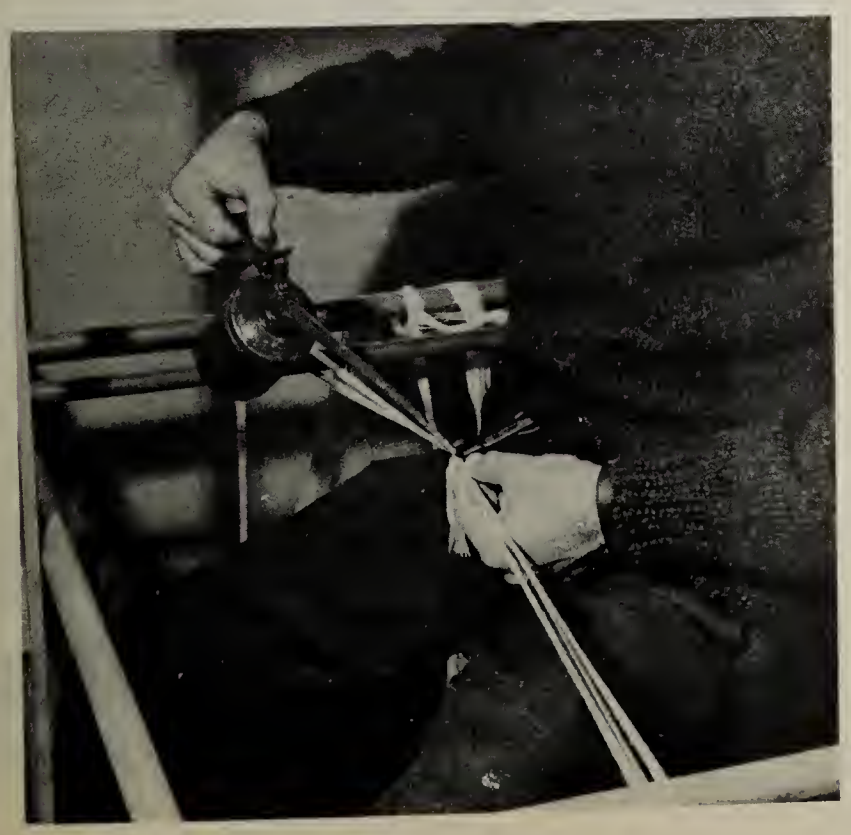


Fig. 14 Oiling the end of the ribbon

Fig. 15 Sitting position

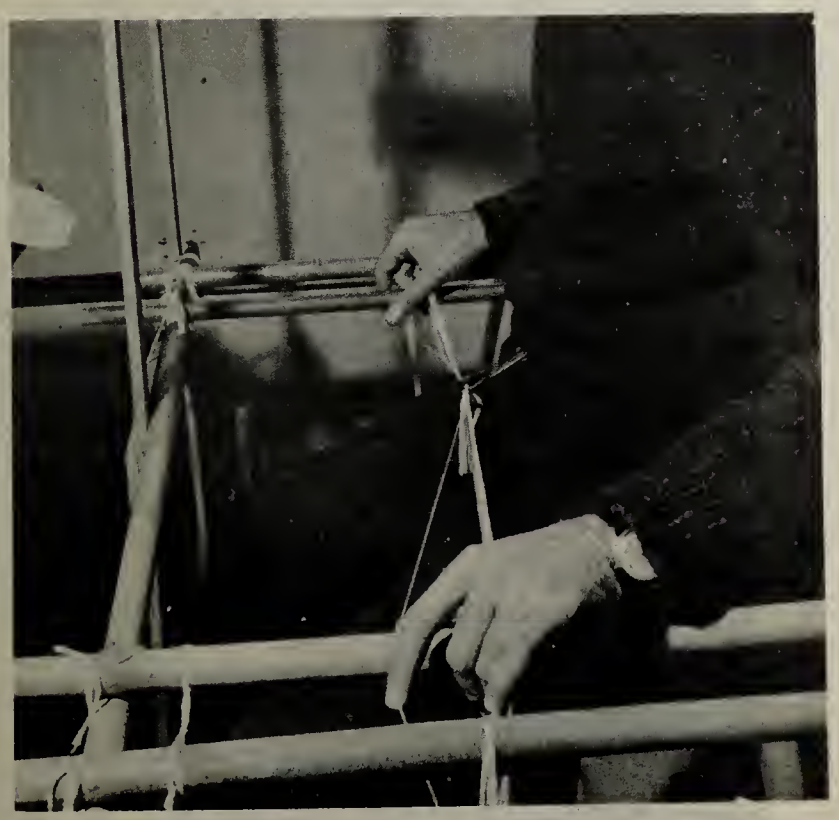


Fig. 16 Separating the yarns

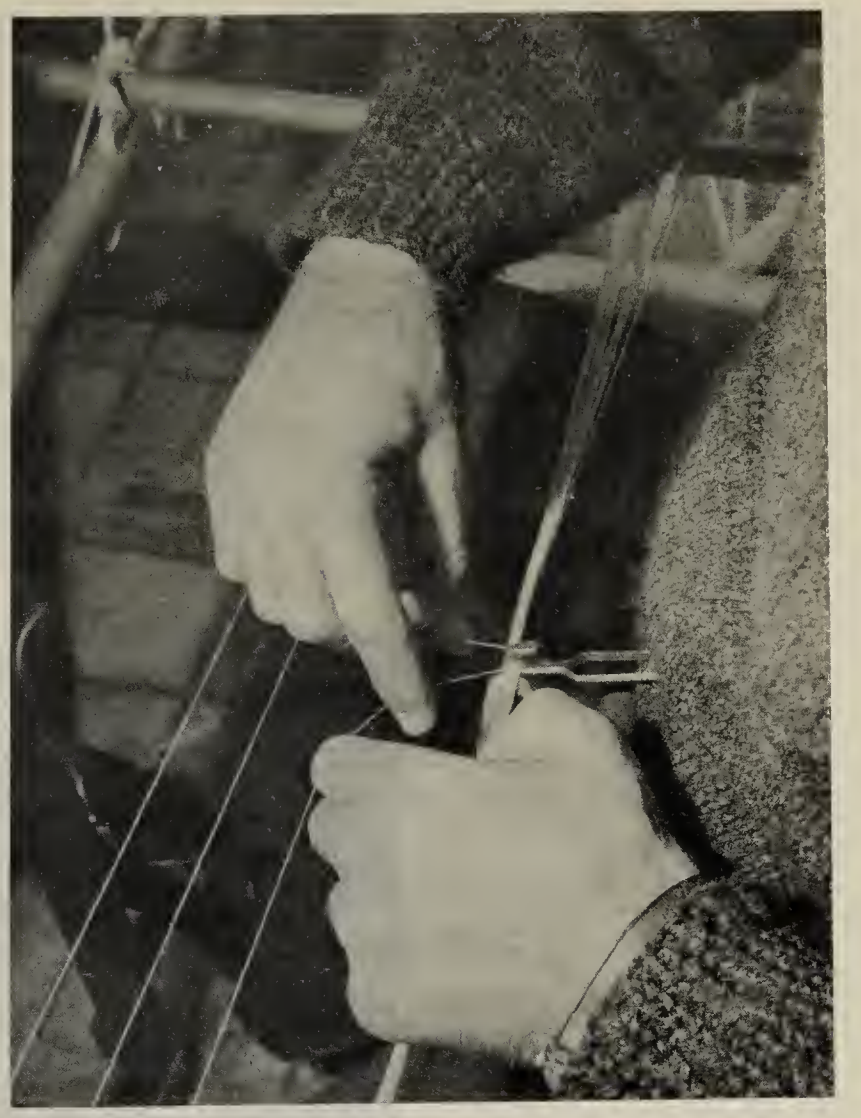


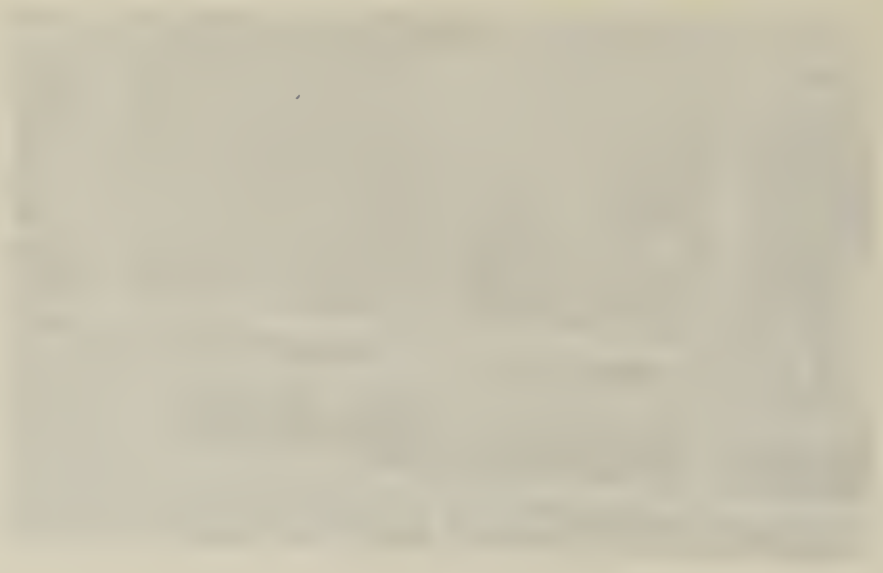
Fig. 17 Grasping two yarns between thumb and fore-finger

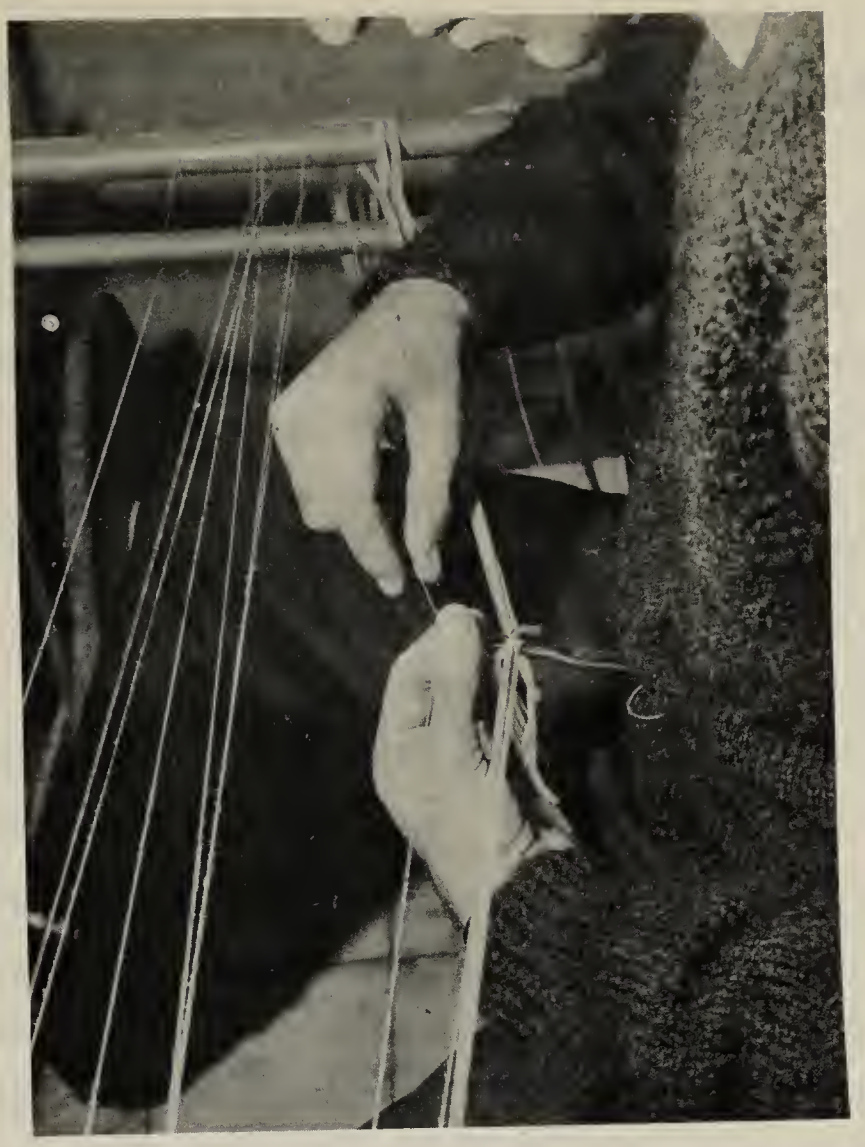
Fig. 18 Cutting the yarns

Fig. 19 Tying-in

Fig. 20 Separating the yarns

Fig. 21 Separating the crossed yarns





ig. 22 Grasping two yarns between thumb and fore-finger

Fig. 23 Shoving the tied yarn forward

4.2. Process: Knotting

PROPOSED METHOD FOR THE BLIND

Right hand - left hand chart

No.	Left hand		Right hand	
	The operations	The movements	The movements	The operations
1.	-taking a ribbon from the old warp and straightening it.	-extends to the left towards the cross rods.	-waits	-taking a ribbon from the old warp and straightening it.
		-is placed on the first cross rod.		
		-slides along the rod towards the body		
		-grasps the ribbon		
		-enters with 4 fingers into the opening fromed by the cross rod, with the thumb above the yarns		
		-slides in the direction of the ribbon's knot	-grasps the end of the ribbon	
		-continues to slide to the end of the ribbon	-pulls the ribbon end (the knot is undone)	
		-holds the ribbon end	-the fingers enter in between the yarns near the first cross rod	
			-the fingers slide along towards the ribbon's end	

(Process: knotting cont.)

No.	Left hand		Right hand	
	The operations	The movements	The movements	The operations
2.	-grasping a ribbon from the new warp and straightening it.	-holds the end of the old ribbon	-stretches out to the right, towards the cross rods	-grasping a ribbon from the new warp and straightening it.
			-rests on the first cross rod	
			-slides along the rod towards the body	
			-grasps the ribbon	
			-enters with 4 fingers into the opening formed by the first cross rod with the thumb remaining above the yarns	
		-grasps the end of the new ribbon	-slides towards the knot of the ribbon	
		-pulls at the end of the ribbon (the knot is undone)	-continues sliding up to the end of the ribbon	
		-the fingers enter between the yarns near the first cross rod	-holds the ends of both ribbons	
		-the fingers slide along to the ribbon's end		

(Process: knotting - cont.)

No.	Left hand		Right hand	
	The operations	The movements	The movements	The operation
3.	-holding the yarns	-	-grasps the ends of both ribbons	-cutting of the superfluous ribbon ends
		-grasps the two ribbons near their ends between the fore - and middle finger, with the thumb and forefinger free. The middle finger, the ring finger and the little finger press the yarns into the palm. The ribbons are taut.	-Places them between the fore- and middle finger of the left hand.	
		-holds the ribbons tautly at the level of the waist	-stretches out towards the scissors	
			-gets hold of the scissor's handle	
			-supports the scissor blades with the part adjacent to the little finger	
			-lifts the scissor handles slightly	
			-cuts the superfluous ribbon ends	
			-replaces the scissors in their place	

(Process: knotting - cont.)

No.	Left hand		Right hand	
	The operations	The movements	The movements	The operations
4.	-finding the yarns to be knotted		-stretches out to the left, towards the crossed yarns of the old warp, above the yarns -is placed on the first cross rod -the forefinger slides along the inside of the rod, towards the body, thus shoving the yarns -the forefinger slides towards the crossed yarns -the forefinger separates the yarn from the other yarns -the thumb slides along the yarn from the other side of the rod	-finding the yarns to be knotted

Remark: If the yarn is not separated after sliding along the first cross rod, the operator should slide along the second cross rod.

		-the forefinger and thumb slide along the yarn up to its end -the forefinger and thumb pull the yarn away from the other yarns	
	-grasps the yarn between the forefinger and thumb	-the forefinger and thumb place the yarn between the left hand's forefinger and thumb	

(Process: knotting - cont.)

No.	Left hand		Right hand	
	The operations	The movements	The movements	The operations
4.	cont.	-holds the ribbons	-stretches out to the right, towards the new warp's crossed yarns, and above them -is placed on the first cross rod -the forefinger slides along the inside of the rod towards the body thereby shoving the ribbon yarns -slides to the crossed yarns -separates the yarn from the other yarns -the thumb slides along the other side of the cross rod -the forefinger and thumb slide along the yarn to its end	
5.		-holds both ribbons in the palm and holds the yarn from the old warp between fore-finger and thumb	-the forefinger and thumb pass the new yarn over the old yarn and towards the body -the forefinger and thumb push the end of the yarn downwards	-knotting

(Process: knotting - cont.)

No.	Left hand		Right hand	
	The operations	The movements	The movements	The operations
5.	cont.		-the middle finger is hooked under the old yarn	
			-gets hold of the yarn by means of the back of the middle finger with the ring finger pressing the yarn to the middle finger	
			-the middle and ring finger pull the yarn upwards	
			-the thumb and fore-grasp the end of the yarn	
		-the forefinger and thumb slide towards the body in order that a suitable loop may be formed	-twists the yarn clockwise around the fore and middle finger, the fingers are held vertically to the yarns	
			-inserts the end of the yarn between the fore-finger and middle finger, by means of the thumb - from below	
			-grasps the end of the yarn with the fore- and middle finger	
			-the fore - and middle finger pull the yarn end downwards	

(Process: knotting - cont.)

No.	Left hand		Right hand	
	The operations	The movements	The movements	The operations
5.	cont.	-tautening of the yarn end from the old warp	-the fore - and middle finger tauten the yarn end with the thumb joining in	
6.	-holding the ribbons	-holds both ribbons	-releases the yarn end towards the body in the direction of the floor -shoves the knotted yarn away from the body with the back of the fingers	-shoving the knotted yarn forward

Remark: Operations Nos.1-3 are carried out with each ribbon.
Operations Nos.4-6 are carried out with each yarn.

4.3. The process: Tying-in with both hands

RECOMMENDED METHOD FOR THE BLIND.

Right - and Left hand chart

No.	Left hand		Right hand	
	The operations	The movements	The movements	The operations
1.	-Tying the hook around the waist	-waits	-stretches out to the hook	-Tying the hook around the waist
			-grasps the hook	
			-brings the hook near the body	
		-grasps the second end of the rope	-grasps one end of the rope	
		-passes the rope around the waist	-Passes the rope around the waist	
		-ties a simple knot	-ties a simple knot	
2.	-Taking a ribbon from the old warp and straightening it.	-stretches out to the left towards the cross rods	-waits	-Taking a ribbon from the old warp and straightening it.
		-stretches out to the first cross rod		
		-slides along the rod towards the body		
		-grasps the ribbon		
		-enters with 4 fingers into the aperture in the yarns, formed by the first rod, with the thumb above the yarns		

(Tying-in with both hands - cont.)

No.	Left hand		Right hand	
	The operations	The moemvents	The movements	The operations
2.	cont.	-slides towards the knot in the ribbon	-grasps the end of the ribbon	
		-continues to slide,up to the end of the ribbon	-pulls the end of the ribbon (the knot is undone)	
		-holds the end of the ribbon	-the fingers are inserted between the yarns,near the first cross rod	
			-are slid to the end of the ribbon	
3.	-tying a knot in the ribbon of the old warp	-holds the end of the ribbon	-enters below the yarns which are above the back of the fingers	-tying a knot in the ribbon from the old warp
		-releases a little the ribbon yarns	-turns clockwise, from below upwards,winding the ribbon yarns around all the fingers	
		-proferrs the end of the ribbon to the right hand	-the thumb and forefinger grasp the ribbon end	
		-checks that the knot is tied opposite the hook	-the thumb and forefinger pull the end of the ribbon	
			-releases the ribbon, on the left thigh	

(Tying-in with both hands - cont.)

No.	Left hand		Right hand	
	The operations	The movements	The moevements	The operations
4.	-Taking a ribbon from the new warp and straightening it.	-waits	-stretches out to the right, towards the cross rods	-taking a ribbon from the new warp and straightening it.
			-is placed on the first cross rod	
			-slides along the rod towards the body	
			-grasps the ribbon yarns	
			-enters with 4 fingers into the opening formed by the first cross rod, with the thumb remaining above the yarns	
		-grasps the end of the ribbon	-slides towards the knot in the ribbon	
		-pulls the end of the ribbon (the knot is undone)	-continues sliding to the end of the ribbon	
		-the fingers pass in between the yarns near the first cross rod	-holds the end of the ribbon	
		-the fingers slide to the end of the ribbon		
5.	Tying a knot in the ribbon from the new warp	-enters below the yarns which remain above the back of the fingers	-holds the end of the ribbon	-tying a knot in the ribbon from the new warp

(Tying-in with both hands - cont.)

No.	Left hand		Right hand	
	The operations	The movements	The movements	The operations
5.	cont.	-turns anti-clock-wise from down, upwards, thus winding the ribbon yarns around all the fingers	-releases the ribbon yarns, a little	
		-the thumb and forefinger grasp the ribbon's end	-proffers the end of the ribbon to the left hand	
		-thumb and fore-finger pull the end of the ribbon	-makes sure the knot is tied opposite the hook	
		-the thumb and forefinger transfer the ribbon's end to the right hand	-grasps the ribbon's end	
6.	-Joining the two ribbons	-stretches out to-wards the end of the ribbon from the old warp	-	-joining the two ribbons
		-grasps its end		
		-transfers the ribbon's end to the right hand	-grasps the end of the old ribbon	
		-enters into the opening formed by the first cross rod	-releases the end of the old ribbon	
		-grasps the knot of the new ribbon	-transfers the knot of the new ribbon, to the left hand	
		-pulls the knot of the new ribbon		

(Tying-in with both hands - cont.)

No.	Left hand		Right hand	
	The operations	The movements	The movements	The operations
7.	-Inserting the knots of the ribbons into the loop of the hook	-holds the ribbon knots	-grasps the hook	-Inserting the knots of the ribbons into the loop of the hook
		-brings the ribbon knots near the hook-from above	-brings the hook near the ribbon knots	
		-pushes the knots into the loop of the hook	-pulls the knots from below the hook	
			-pulls the ribbon ends away from the body	
8.	-Oiling the ribbon ends		-grasps the oil can handle	-Oiling the ribbon ends
		-rubs the oil into the yarns	-oils the end of the old ribbon	
		- - " -	-oils the end of tne new ribbon	
		- - " -	-replaces the oil can in its place	
9.	-Finding the yarn from the old warp which is to be tied-in	-stretches out to the left towards the cross rods of the old warp, above the yarns	-stretches out to the right towards the cross rods of the new warp, above the yarns	-Finding the yarn from the new warp which is to be tied-in
		-is placed on the first cross rod	-is placed on the first cross rod	
		-the forefinger slides along the inside of the rod, towards the body (shoving the yarns of the ribbon)	-the forefinger slides along the inside of the rod towards the body (shoving the yarns of the ribbon)	

(Tying-in with both hands - cont.)

No.	Left hand		Right hand	
	The operations	The movements	The movements	The operations
9.	cont.	-the forefinger slides towards the crossed yarns -the forefinger separates the yarn from the rest of the yarns	-the forefinger slides towards the crossed yarns -the forefinger separates the yarn from the rest of the yarns	
Note: If the yarn is not separated after sliding along the first cross rod, the operator should slide along the second cross rod.				
10.	-Tying-in	-the thumb slides along the yarn, towards the hook -releases the yarn from the old warp -the forefinger and thumb tie the yarn ends in, in a clockwise direction -releases the yarn ends	-the thumb slides along the yarn, towards the hook -the forefinger grasps the yarn from the old warp -the thumb and forefinger tear the yarns -the thumb and forefinger turn the torn yarn ends upwards -the thumb and forefinger release the yarn ends -the thum presses the tied-in ends to the yarn from the new warp -the forefinger and thumb tie-in, clockwise	-Tying-in

(Tying-in with both hands - cont.)

No.	Left hand		Right hand	
	The operations	The movements	The movements	The operations
11.	-Shoving the tied-in yarn, forward	-enters in front of the yarn, with the latter touching the back of the fingers -shoves the yarn away from the body	-enters in front of the yarn, with the yarn touching the back of the fingers -shoves the yarn away from the body	-shoving the tied-in yarn, forward

Remark: Operation No.1 is carried out at the beginning of the tying-in process
Operations Nos.2-8 are performed with each ribbon.
Operations " 9-11 are performed with each single yarn.

4.4. The process: Tying-in single handed

RECOMMENDED METHOD FOR THE BLIND

Right - and Left hand chart

No.	Left hand		Right hand	
	The operations	The movements	The movements	The operations
9.	-Finding the yarn from the old warp, which is to be tied-in	-stretches out to the left, towards the cross rods of the old warp - below the yarns -is placed below the first cross rod (or, the second) -the forefinger slides along the inner edge of the rod, towards the body (shoving the ribbon yarns) -slides towards the crossed yarns -separates the yarn from rest of the yarns	-stretches out to the right, towards the cross rods of the new warp, above the yarns -is placed on the first cross rod (or, on the second) -the forefinger slides along the inner edge of the rod, towards the body (shoving the ribbon yarns) -the forefinger slides towards the crossed yarns -the forefinger separates the yarn from the rest of the yarns	-Finding the yarn from the new warp which is to be tied-in
10.	-Tying-in	-the thumb glides along the yarn from the old warp, in the direction of the hook -the forefinger grasps the yarn from the new warp -the forefinger and thumb press the two yarns together	-waits	-Waiting

(Tying-in single handedly-cont.)

No.	Left hand		Right hand	
	The operations	The movements	The movements	The operations
10.	cont.	-the forefinger and thumb pull the yarns (the yarns tear off). -the forefinger and thumb tie the yarns ends -in, in an anti-clockwise direction. -the forefinger and thumb tie-in the yarn ends, on the yarn from the new warp, in an anti-clockwise direc-tion		
11.	-Shoving the tied-in yarn forward	-the back of the forefinger shoves the yarn away from the body	-waits	-Waiting

Remark: Operations Nos.1 - 8 are identical to those done when tying-in with both hands

Operations Nos.2 - 8 are carried out with each ribbon

Operations Nos.9 - 11 are carried out with each yarn

A P P E N D I X

1. Knotting
2. Tying-in with boths hands
3. Tying-in single handed

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1.1. Taking a ribbon from the old warp and straightening it

Steps	Key points
1. Grasping the ribbon	a. Left hand b. Grasping the cross rod with the palm c. Sliding towards the body d. Sliding to the end of the ribbon
2. Undoing the knot in the ribbon	a. Right hand b. Pulling the ribbon end with the palm of the hand
3. Straightening the ribbon yarns	a. The fingers of the left hand b. Enter between the yarns c. Sliding to the end of the ribbon

1.2. Taking a ribbon from the new warp and straightening it

Steps	Key points
1. Grasping the yarn ribbon	a. Right hand b. Grasping the cross rod with the palm c. Sliding towards the body d. Sliding to the end of the ribbon
2. Undoing the knot in the ribbon	a. Left hand b. Pulling with the palm of the hand
3. Straightening the ribbon yarns	a. The fingers of the left hand b. The fingers enter between the yarns c. Slides along the yarns, towards the end of the ribbon

1.3. Cutting off the superfluous ribbon ends

Steps	Key points
1. Grasping both ribbons	a. Right hand b. Offers to the left hand
2. Holding both ribbons	a. Tautly b. At the level of the waist c. Between the fore - and middle finger of the left hand d. The back of the hand turned downwards e. The forefinger and thumb are free
3. Grasping the scissors	a. The scissors are in the shirt pocket b. The thumb in one ring of the scissor handle, the fore and middle fingers in the second ring of the scissor's handle (right hand) c. The scissors are held in a horizontal position
4. Cutting off the ribbon ends	a. The scissors supported by the extension of the side of the little finger (bottom of left hand) b. Lowering slightly edge of scissors. c. Wide opening of the handles

1.4. Finding the yarns which are to be tied-in

Steps	Key points
1. Separating the yarn	a. Right hand b. The forefinger shoves (once by sliding on the first cross rod and once by sliding along the other cross rod. c. Sliding towards the crossed yarns. d. The finger seprates the yarn. e. The thumb is turned towards the centre

1.4. Finding the yarns which are to be tied-in (cont.)

Steps	Key points
2. Placing the yarn in the left hand	a. Sliding towards the centre (the forefinger and thumb) b. Pulling the yarn and extracting it from the rest of the yarns c. Placing the yarn between the forefinger and thumb of the left hand
3. Separation of the yarn	a. Right hand b. The forefinger shoves (once by sliding along the first cross rod and once by sliding along the second one)
4. Holding the yarn at its end	a. The forefinger and thumb b. Sliding towards the centre

1.5. Knotting the yarns

Steps	Key points
1. Passing one yarn around the other	a. Right hand, the forefinger and thumb b. Above the yarn from the old warp towards the body c. The middle finger below the yarn from the old warp d. The ring finger closes around the yarn and the middle finger e. Pulling upwards f. Grasping the yarn end with the thumb and forefinger
2. Forming a loop	a. In a clockwise direction b. Around the fore- and middle finger c. The forefinger and thumb of the left hand slide downwards d. The fingers of the right hand are vertical to the yarns

1.5. Knotting the yarns (cont.)

Steps	Key points
3. Inserting the yarn end into the loop	a. From below b. With the thumb into the space between fore - and middle finger c. Pulling upwards d. Pulling both ends (the end of the yarn from the new warp with the forefinger, the middle finger and the thumb. The end of the yarn from the old warp, with the forefinger and thumb of the right hand).

1.6. Shoving the knotted yarn forward

Steps	Key points
1. Releasing the yarn	a. Downwards b. Towards the body
2. Shoving the yarn	a. Away from the body b. With the back of the fingers

Remark: Operations Nos. 1-3 are carried out with every ribbon.
Operations Nos. 4-6 are carried out with every single yarn.

2. TYING-IN WITH BOTH HANDS

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2.11. Shoving the tied-in yarn forward 139

2.1. Tying the hook around the waist

Steps	Key points
1. Getting hold of the hook	a. Right hand b. Bringing the hook near the body
2. Girthing the rope ends around the waist	a. With both hands b. They slide along to the rope ends c. They girth the rope around the waist
3. Tying the hook around the waist	a. The rope hand held in the right hand is transfered to the left hand and vice versa b. The rope end in the right hand, from above, around the rope from the right c. Pulling the ends d. The right end of the rope around the left end e. Pulling the ends

2.2. Taking a ribbon from the old warp and straightening it

Steps	Key points
1. Grasping the ribbon	a. Left hand b. Is placed on the first cross rod c. Is slid towards the body
2. Undoing the knot	a. The left hand enters into the aperture formed by the first cross rod b. Slides up to the knot c. The right hand grasps the ribbon's end d. Pulls the ribbon's end
3. Straightening the yarns	a. The left hand holds the ribbon's end b. Right hand. The fingers enter between the yarns near the first cross rod. c. Slide to the ribbon's end

2.3. Tying a knot in the ribbon from the old warp

Steps	Key points
1. Holding the ribbon	a. The left hand b. The end of the ribbon
2. Tying the knot	a. The right hand b. Enters below the yarns, from down to the top, twising clockwise c. Around all fingers d. The humb and forefinger grasp the ribbon end offered by the left hand e. Pulling the end f. The left hand cheks and ascertains that the knot is tied opposide the hook

2.4. Taking a ribbon from the new warp and straightening it

Steps	Key points
1. Grasping the ribbon	a. The right hand b. Is placed on the first cross rod c. Slids towards the body
2. Undoing the knot in the ribbon	a. The right hand enters into the aperture formed by the first crossrod b. Slides up to the knot c. The left hand grasps the ribbon's end d. Pulls the ribbon's end
3. Straightening of the yarns	a. The right hand holds the ribbon's end b. Left hand, the fingers enter between the yarns, near the first cross rod c. Slide towards the ribbon's end

2.5. Tying a knot in a ribbon from the new warp

Steps	Key points
1. Holding the ribbon	a. The right hand b. The end of the ribbon
2. Tying the knot	a. The left hand b. Enters below the yarns, twists anti-clockwise, from below to the top c. Around all the fingers d. The thumb and forefinger grasp the ribbon end offered by the right hand e. Pulling the end f. The left hand checks that the knot is tied opposite the hook

2.6. Joining the ribbons

Steps	Key points
1. Grasping the ribbons	a. The right hand b. The left hand enters into the yarn aperture formed by the first cross rod of the old warp
2. Joining ribbon to ribbon	a. The right hand holds out the knot of the new ribbon, to the left hand b. The left hand grasps the knot c. Pulls the knot

2.7. Inserting the ribbon knots into the loop of the hook

Steps	Key points
1. Grasping the hook	a. Right hand b. Brings the knots near the hook

2.7. Inserting the ribbon knots into the loop of the hook (cont.)

Steps	Key points
2. Grasping the knots	a. The left hand b. Brings the knots near the hook
3. Inserting the knots into the loop of the hook	a. The left hand pushes the knots from above b. The right hand pulls from below c. Shoving the knots away from the body

2.8. Oiling the ribbon ends

Steps	Key points
1. Grasping the oil can	a. The right hand b. The thumb rests on the lever
2. Oiling	a. The right hand oils b. The left hand rubs the oil into the yarns

2.9. Finding the yarns which are to be tied-in

Steps	Key points
1. Finding a yarn from the new warp and separating it	a. The right hand is above the yarns b. The forefinger slides along the first (or second) cross rod, towards the body c. Sliding towards the crossed yarns d. Separating the yarn from the rest of the yarns
2. Finding the yarn from the old warp and separating it	a. The left hand is above the yarns b. The forefinger slides along the first (or second) cross rod,towards the body c. Sliding towards the crossed yarns d. Separating the yarn from the rest of the yarns.

2.10 Tying-in of the yarn

Steps	Key points
1. Grasping and tearing the two yarns	a. the thumbs of the right and left hands slide along the yarns, towards the hook b. The thumb and forefinger grasp the yarns and put them between them c. Pressing the yarns to the hook
2. Tying-in both ends	a. The right hand holds on b. The left hand, the forefingers and thumb tie-in c. In a clockwise motion
3. Final tying-in	a. The right hand, forefinger and thum b. Pressing the ends against the yarn from the new warp c. Tying-in clockwise

2.11 Shoving the tied-in yarn forward

Steps	Key points
1. Shoving the yarn	a. Both hands b. On both sides of the tied-in yarn c. The yarn touches the back of the fingers d. Shoving away from the body

Remark: Operation No. 1 is performed at the beginning of the piecing (tying-in)

Operations Nos. 2 - 8 are carried out with each ribbon

Operations Nos. 9 -11 are carried out with each single yarn.

3. TYING-IN SINGLE HANDED

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3.9. Finding the yarns to be tied-in 143

3.10. Tying-in of the yarns 143

3.11. Shoving the tied-in yarn, forwards 143

Remark: Operations Nos.1-8 are identical to the same operations, as carried out when tying-in with both hands.

3.9. Finding the yarns to be tied-in

Steps	Key points
1. Finding the yarn from the new warp and separating same	a. The right hand is above the yarns b. The forefinger slides along the first (or second) rod, towards the body c. Sliding towards the crossed yarns d. Separating the yarn from the rest of the yarns

3.10. Tying-in the yarns

Steps	Key points
1. Grasping and tearing the yarns	a. The left hand, forefinger and thumb b. Pressing the yarns together c. Pulling and tearing the yarns
2. Tying-in the two yarn ends	a. Forefinger and thumb of the left hand b. Pressing the yarn ends to the new yarn c. In a clockwise movement

3.11. Shoving the pieced yarn - forward

Steps	Key points
1. Shoving the yarn	a. The left hand b. The back of the forefinger c. Away from the body

Remark: Operations 2 - 8 are carried out with every ribbon
Operations 9 -11 are carried out with each single yarn.

HV1711 Kishroni, A. and M. c.1
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SURVEY, EXAMINATION OF THE PROSPECTS FOR PLACING THE BLIND IN THE WEAVING...(1965)

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